

TATE & LYLE
CENTRAL AGRICULTURAL RESEARCH
STATION

ANNUAL REPORT
1961 - 1962



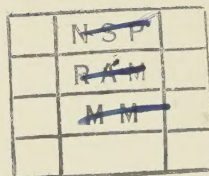
Nymphal Stages of the Sugarcane Froghopper, Aeneolamia varia saccharina

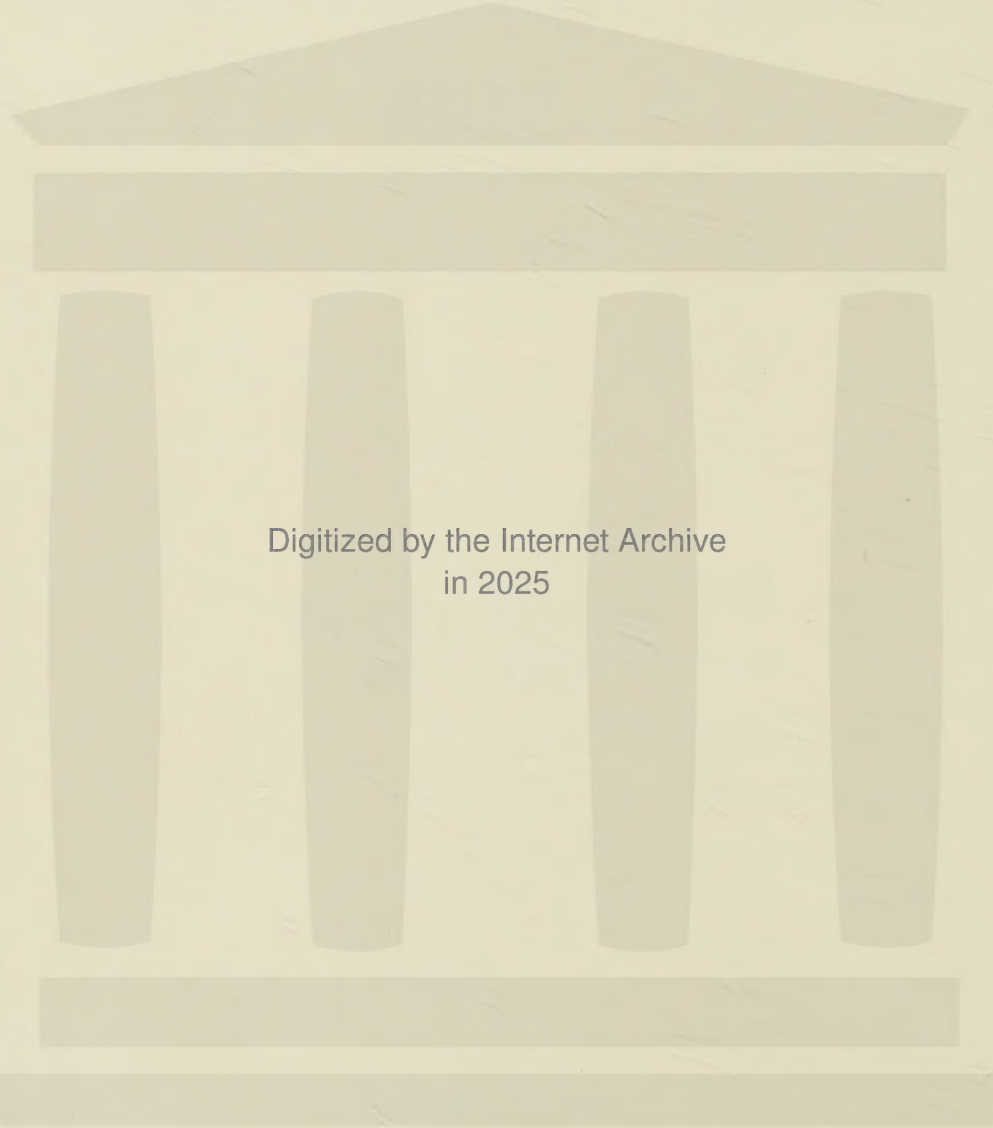
Carapichaima, Trinidad, West Indies.

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STATEMENT BY MR. J.A.C. HUGILL, CHAIRMAN, RESEARCH COMMITTEE

Ever since the days of Sir Francis Bacon, who is credited with having altered the basis of philosophic thought from the Aristotelean to the deductive method and thus to have founded modern science, there has been a tug-of-war in men's minds, particularly in the minds of those who are involved in business, as to the real value of research.

It is nice and easy to point to quick results obtained from experiments in a limited field of endeavour, but real research must include a considerable proportion of work which may or may not produce results which are going to be immediately applicable.

The majority of the more world-shaking discoveries have resulted, anyway in the last half century, from the almost accidental coincidence of a research worker of great ability and phenomenon which he has not necessarily been expecting to observe. What has mattered has not been, for example, the fact that a Fleming has been really looking for penicillin, but that while researching he has happened to observe a particular fungus and from its behaviour has been able to deduce what might be applied to the result of his observations—the operative word being “might.”

When the Royal Society was founded in the 1660's many half-baked experiments were undertaken. Some of them, such as Boyle's, led to something. Others led to nothing. They were all, however, important because they were *experiments*, because they were work done on the “suck-it-and-see” basis. (The fact that King Charles II was a strong supporter of such activities when he became first President of the Royal Society need not, however, be attributed to his friendship for Nell Gwynn, the lady who used to sell oranges in the theatre!).

Seriously though, as Chairman of the Research Committee, I don't think it is safe to neglect any field of research which can be remotely comprehended as being applicable to sugar cane. Some of the results we get will be almost immediately applicable. For others, application will become a long frustrating and difficult business, and will require intense and friendly co-operation between those who are researching full-time and those whose job is to help translate the results of research into the practical every-day farming of cane.

What we are aiming for is to increase our yield of *sugar*, either by teaching sugar cane to grow more efficiently, or by helping it to do so ourselves. A 10% increase in sugar production per acre, if we can obtain that, will be of immense value, not only to us, or to Trinidad, or to the West Indies, but to the tropical world as a whole.

I am delighted to write an introduction to this report on a year's work from C.A.R.S., not only because of its intrinsic value but for purely personal reasons, because I am a research-worker manque.

From 1st January 1963, the C.A.R.S. will be working under the name of Tate and Lyle. This is no slur on Caroni and Ste. Madeleine, but is a sign that the Parent Company feels honoured to be associated with the important and fundamental work which is being done in Trinidad. There are only two other places where work of such quality is going on, Hawaii and Queensland.

Good luck to C.A.R.S. and to all of us who hope to benefit from it.

J.A.C. HUGILL,
Chairman, Research Committee.

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Member of Board of Tale & Lyle Ltd., and member of Technical Policy Committee, Tata and Lyle Ltd.

J.G. Fairrie, Director, and Member of Board, Caroni Limited, and West Indies Sugar Co., Ltd.

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ACKNOWLEDGEMENTS

Research on a sugar estate is rarely successful without some assistance and co-operation from a considerable number of individuals and groups. We have been fortunate indeed in having had, during 1962, the active co-operation, worthwhile advice, and encouragement of the Research Committee. Similarly we wish to thank for their day to day co-operation, the General Managers of Caroni Limited, and of the Ste. Madeleine Sugar Co., Ltd., their Agricultural Staffs, and the many individuals comprising their respective Factory and Business sections. We also wish to acknowledge the ready assistance of Unital (Trinidad) Limited, whose Staff has diligently acted on our behalf on many occasions throughout the year.

As one glances through the pages which follow, it is obvious that they comprise a vast number of observations and tabular data. To our field assistants we express gratitude for the many hours which they spent counting froghopper nymphs, weeds, and measuring heights of cane stalks, as well as completing a number of other necessary field tasks. We wish to thank also Mr. D. Raman who, together with Mrs. V. Singh, typed the manuscript.

A special note of thanks is due Mr. G.W. Smith of the Regional Research Centre, University of the West Indies, St. Augustine, for his valuable assistance in establishing a weather station at C.A.R.S., and for contributing to our Annual Report an interesting paper on climatology.

A.J. Vlitos
Director of Research.

INTRODUCTION

The Tate and Lyle Central Agricultural Research Station (formerly the Central Agricultural Research Station for Caroni Limited and the Ste. Madeleine Sugar Co., Ltd.) is intended to pursue fundamental and applied research relating to sugar cane. From the time of its inception the Research Station has maintained a balance between the long-range and the more immediate agronomic research.

The basic programmes in plant physiology, entomology, and microbiology are aimed at accumulating knowledge. Such knowledge, although not always applied immediately, offers a sounder base from which to launch more precise field experiments. From precision in field trials come the more significant practical agronomic advances. Particularly fruitful in this respect have been the long-range studies in plant physiology and entomology.

Fundamental studies during 1960 to 1962 on the natural auxins of sugar cane had shown that growth and development were being regulated by a number of different growth substances. Some of these growth substances were inhibitory, while others were stimulatory. In field experiments the agronomists, while studying chemical induction of ripening in sugar cane, found that a mixture of two growth regulants (2,3,6-trichlorobenzoic acid and 2-methyl-4-chlorophenoxyacetic acid) enhanced sucrose deposition if applied a few weeks prior to harvest. Meanwhile, studies in Australia had shown that auxins directly regulate the level of invertase in cane tissues. The possibility exists therefore that auxins may have a direct bearing on sucrose metabolism through an intermediate action on invertase. Whether or not the influence on juice quality of 2, 3, 6-trichlorobenzoic acid and 2-methyl-4-chlorophenoxyacetic acid is linked to an inhibition of invertase has not as yet been determined. It is hoped that the knowledge gained from the fundamental studies on natural auxins, coupled with the information from Australia, shall place the practical chemical regulation of cane ripening on a much less empirical basis.

Similarly, the long-range studies on the physiology and ecology of the frog hopper (*Aeneolamia varia saccharina* Distant) have been instrumental in designing more meaningful insecticide trials. The incorporation of a new field plot design into the insecticide screening programme has led to a more precise evaluation of the residual activity of insecticides. It had often been noted in the past that the residual activity against frog hopper nymphs by a given insecticide persisted much longer in large-scale applications on the Estates than in small-scale experimental plots. The discrepancy was suspected to be due to re-infestations of the small-scale plots by adult frog hoppers migrating from adjacent control plots. Thus in 1962 trials the treated plots were completely surrounded by controls, favouring re-infestations and permitting a more precise evaluation of residual activity. Employing this stringent design, it was shown that very few of the insecticides available at present persist in soil for much more than 60 days. If migration of adult frog hoppers into treated areas is restricted, an insecticide may "appear" to persist for 90 to 100 days, but this is only an "apparent" residual effect. On the Estates, where entire fields are dusted and where re-infestations are kept at a minimum, the "apparent" residual activity of a given insecticide may often be greater than the "actual residual activity."

Basic studies on the physiology and ecology of frog hopper eggs, reported under the Entomology section, may in future also lead to experimental designs which could facilitate the evaluation of ovicides.

A brief account of the major developments in research during 1962 are presented in the Introduction. More detailed data and discussion appear under the appropriate heading in the text.

I. AGRONOMY

The agronomic research programme is concerned with the solution of a number of immediate, practical problems. Heading the list of important problems is frog hopper control, followed by chemical weed control, mineral nutrition, the selection of new varieties, and the chemical regulation of ripening. Outlined below are the more significant research developments in each of these fields during 1962.

A. Frog hopper Control

Two new insecticides, Folidol M-40 and Thiodan, have shown promise for the control of frog hopper nymphs. Folidol M-40 is an organo-phosphate with relatively long residual activity. At Ste. Madeleine the compound was effective when applied to the base of cane stools which had not been previously cleared of trash and weeds, while at Caroni Limited, Folidol applied to "clean" stools showed residual activity comparable to that of Trithion and Thimet.

Thiodan represents a chemical structure which has not previously been employed against the frog hopper. In trials at Caroni Limited, Thiodan exhibited persistent residual activity and compared favourably with standards. Thiodan and Folidol might well fit into the rotational system of insecticide usage, along with Trithion, Thimet, Sevin, Dieldrin, Telodrin, DDT, and Agrocide.

During 1962, Thimet, Sevin, Dieldrin, Agrocide, and Telodrin were "rotated" in Ste. Madeleine fields requiring protection against frog hopper. Each of the compounds performed well and at the time of writing (November 1962) blight is negligible in treated fields. Similarly at Caroni Limited, Trithion dust has effectively controlled blight in the majority of treated fields. Dieldrin was used on a relatively restricted acreage at Washington Section of Caroni Estate where, in the 1961 experiments, DDT had shown activity against previously resistant nymphs. Thus far all indications point to the susceptibility of frog hopper nymphs to chlorinated hydrocarbons, but the residual activity of Dieldrin has not matched that of DDT. The results are encouraging, for it may be possible to employ the less-expensive chlorinated hydrocarbons in rotation with other types of insecticides. Combinations of DDT (which has shown exceptionally persistent residual activity) with a quick-acting compound such as Malathion or Sevin might well fit into a practical field programme.

Granular formulations of various insecticides were also evaluated during the year. Trithion granular (10%) did not control frog hopper nymphs as effectively as Thimet granular (10%), applied either over trash or to "clean" stools. Granular formulations of Thimet were more effective than granules of the chlorinated hydrocarbons, especially when applied to the base of cane stools which had not been cleared of trash and weeds. Field observations at Caroni Limited confirmed that Trithion granular performed inconsistently unless trashing and weeding preceded the applications. Trithion dust applied to "clean" stools replaced Trithion granular on the Estates, once it was noted that granular formulations were relatively ineffective.

In trials at Ste. Madeleine, Folidol was effective in controlling nymphs, even though it was applied over trash and weeds. Since Folidol is applied as a liquid, it might prove feasible to employ low-volume power sprayers to force the spray through dense trash and weeds and thereby effect uniform distribution of toxicant. The compound is cost-competitive with standards.

B. Weed Control

Several economical and effective pre-emergence weed killers were uncovered during 1962. At Caroni Limited it was shown that "Pesco 1815" (a mixture of trichlorobenzoic acid and 2-methyl-4-chlorophenoxyacetic acid) with a single application of 2 gallons per acre (i.e. \$12 B.W.I.) would control weeds for over a five month period. Two new substituted urea herbicides (Hercules 7531

and 7175) also performed as well as standards and on a cost-performance basis hold promise of being superior to the chemicals presently being used on the Estates. At Ste. Madeleine granular formulations of atrazine, simazine, and amiben, applied pre-emergence to weeds and crop, controlled weeds as effectively as liquid formulations, containing comparable quantities of active ingredient. Fenac also showed considerable promise on the soils in the Ste. Madeleine area, as well as at Caroni Limited. Under Trinidad conditions any of the following pre-emergence herbicides are available for use: atrazine, diuron (Karmex), fenac, Pesco 1815, amiben, and Kuron. The choice of herbicide depends a great deal upon selectivity to the variety of cane being grown, upon differences in soil and drainage conditions, and upon the price of material. In general the combinations of atrazine + 2, 4-D + dalapon (at Caroni Limited) and diuron + 2, 4-D (at Ste. Madeleine) have performed satisfactorily, but it may be possible to improve upon these, from a cost standpoint, by introducing large-scale extension trials during 1963 with some of the newer materials. Pesco 1815 at \$12 (B.W.I.) per acre represents one of the most economical of the newer pre-emergence herbicides.

C. Mineral Nutrition

Mineral nutrition, and the formulation of rational fertilizer programmes on a diverse number and types of soil, has undergone extensive investigation. At Caroni Limited the majority of fertilizer experiments have confirmed that present Estate practices are sound. A series of foliar diagnoses in factorial experiments revealed, on a number of different types of soils, that inter-relationships hold between (a) the quantity of N, P, or K added to the soil, (b) the quantity of N, P, K, found in the top-visible dewlap at 4 to 5 months, and (c) final yields expressed as TS/A, TC/TS, or TC/A. It would be feasible to incorporate a limited programme of foliar analysis in selected areas on the Estates. Such analyses should be particularly helpful on soils which, at present, may appear to contain adequate quantities of these elements.

At Ste. Madeleine it was shown that an initial phosphate application to plants, applied in furrow at planting, provided a sufficient source of this element for succeeding ratoons. Phosphate applications to ratoons on the Estates might well be discontinued without jeopardizing yields. More research is needed to determine the reasons for the relatively minor responses to nitrogenous fertilizers on certain soils in the Ste. Madeleine area.

D. Selection of New Varieties

The selection of new, higher-yielding varieties has proceeded satisfactorily. During the past three years sweeping changes have been made in the variety programme at Ste. Madeleine. Following successful field trials with B 49119 and B 50112, these two varieties have been extended, while the older standards B 37161 and B 37172 are being replaced rapidly. B 49119 now represents 23.6%, B 50112 13.2%, and B 41227 7.2% of the total acreage to be reaped during 1963. Recent trials have shown B 54262, B 5449, B 54142, B 55304, B 5557, and B 55252 to be the most promising of the newer Barbados varieties.

Large scale factory testing of B 49119, B 50112, and B 41227, carried out at Reform Factory by Estate personnel during the 1962 Crop, revealed several significant points. B 49119 and B 41227 gave approximately equivalent juice qualities, but B 49119 averaged 4 to 5 more tons cane per acre than B 41227. B 50112 gave disappointingly poor juice qualities, but its cane yield per acre was 2 to 3 tons raw cane greater than B 41227, but slightly lower than that of B 49119. Although B 50112 is highly regarded as a "agronomic" cane, noted for its rapid germination and rate of seedling growth, which in turn tends to reduce weeding costs, it is nevertheless doubtful that these factors would offset the extra costs of harvesting and processing imposed by its relatively low sucrose content.

Applying the Fairrie formula, (i.e. "pre-processing costs per ton sugar" = $R \left(\frac{C}{Y} + H \right)$ where $R = TC/TS$, $C =$ costs of cultivation per acre, $Y = TC/A$, and $H =$ harvesting costs per ton cane) it was found at Ste. Madeleine for the 1962 crop that B 49119 was the most "economic" variety as ratoons and B 4362 the outstanding variety as plant cane. For the present analyses $C =$ \$240 (B.W.I.) and $H =$ \$7.20 (B.W.I.). These figures are probably much higher than actual costs, but the relative rankings of varieties, as shown in the following table, would not be affected.

PLANT CANE		RATOONS	
Variety	Pre-processing costs in BWI dollars per ton sugar	Variety	Pre-processing costs in BWI dollars per ton sugar
B 4362	\$136.78	B 49119	\$132.41
B 49119	138.06	B 3337	133.11
B 41227	145.93	B 45152	144.55
B 37172	155.06	B 48228	146.20
B 50112	155.73	B 46378	148.56
B 4747	158.24	B 4747	148.82
B 37161	167.07	B 4362	152.47
B 45224	186.68	B 41227	155.49
		B 37161	156.29
		B 50112	160.75
		B 48231	162.34
		B 4744	172.13
		B 45224	175.06
		B 37172	179.07

E. Crop Quality

Poor juice qualities, at the onset of harvest, have plagued the Trinidad sugar grower for many years. Generally the adverse TC/TS ratios occur in canes reaped in late December to early February, coinciding with the end of the rainy season. In 1960 a number of preliminary experiments indicated that TC/TS ratios might be modified in the field by chemical treatments applied a few weeks prior to harvest. The most effective treatments were various types of plant growth regulants.

During 1962, large-scale field trials involving the application by helicopter of a mixture of trichlorobenzoic acid and 2-methyl-4-chlorophenoxyacetic acid ("Pesco 1815") resulted in highly significant statistical differences in TC/TS ratios between treated and untreated halves of fields of the same sugar cane variety. Fields of approximately 20 acres in size, treated with 4 lbs. per acre of Pesco 1815, at 28 days after the spray was applied, yielded a TC/TS value of 8.95 as opposed to 9.40 in untreated blocks.

In small-scale field plots, Sucrol at 1½ U.S. gallons per acre, at 21 days after treatment, yielded canes with a TC/TS ratio of 11.17 as opposed to 13.17 in controls. Unfortunately a "wild-cat" strike at the Brechin Castle Factory interfered with the large-scale factory analyses. Further trials are planned during 1963.

The evidence to date strongly supports the theory that ripening of sugar cane may be enhanced by treating fields prior to harvest with growth regulants. As more information is gathered on the naturally-occurring substances influencing ripening, it may be possible to apply the information to improve rendement on a field scale.

II. ENTOMOLOGY

A. Studies on the Physiology of Froghopper Blight

In co-operation with the plant physiologist preliminary experiments were carried out to test the effects on plant growth of extracts of salivary glands dissected from adult froghoppers. The extracts were bioassayed in the oat first-internode test. Aqueous extracts of the salivary glands consistently caused a significant elongation of the oat sections. Paper chromatography of the glands in acetone: water (70:30) seemed to mask or to destroy the growth factor(s). Instead, a definite inhibition of growth was obtained with eluates from the solvent front (Rf. 0.9 — 1.0) of chromatograms on which the glandular extracts had been developed. The possibility that growth-promoting and growth-inhibiting factors may occur in the salivary sections of the froghopper is intriguing and deserves further study. It may well be that the observed growth promotion in oat sections with salivary glandular extracts is the result of enzyme action within the oat tissue, liberating a "bound" auxin.

B. Studies on the Physiology of Froghopper Eggs

Observations on the oviposition and hatching of froghopper eggs during the dry season have yielded some interesting new information regarding the fecundity and longevity of froghopper females, and the nature of the diapause occurring in "long-term" eggs. The studies involved the rearing of adult froghoppers collected from the field at various intervals between 15th December 1961 and 22nd March 1962, and the culture of eggs laid by these adults. Some of the eggs were used for experimental work to test the effects on viability and hatching of applications of farnesol and phytol and of drying and chilling. The main results are summarised below.

1. Individual dry season females lived for one to 25 days in captivity and laid from nil to 294 eggs. Maximum longevity and fecundity are estimated at 20 to 30 days and 280 to 340 eggs, respectively.

2. Eggs laid by dry season froghopper females exhibit widely varying degrees of diapause. There is no clear cut distinction between "short-term" (non-diapause) and "long term" eggs, as hatching takes place at all times over the range 14 to more than 200 days when eggs are maintained under moist conditions at normal outdoor temperatures. Individual dry season females may lay eggs requiring widely different incubation periods for hatching, even on the same day.

3. Some measure of the average degree of diapause in a batch of eggs is given by the ratio of the number hatching in a given time to the total number of viable eggs, or, if the latter is not known, to the number hatching at some other fixed time. Measured in this way the degree of diapause varies considerably over the period of observation. It does not seem to be correlated with the photoperiod at the time of oviposition; the degree of diapause in eggs laid during December (day length 11 h. 30 m. to 11 h. 34 m.) was much less than that in eggs laid in January and February (day length 11 h. 31 m. to 11 h. 54 m.) However, it does seem to be correlated with the day length experienced by the insect at some earlier period of its life history, probably at some time during the nymphal phase.

4. Application of pure farnesol (synthetic juvenile hormone of insects) to froghopper eggs usually results in a decreased viability and a prolongation of the average incubation period required for hatching. This seems to be true for both long and short term eggs. One experiment with a related compound, phytol, indicates that its effect on short term eggs is similar to that of farnesol.

5. Keeping froghopper eggs of the diapause (long term) type dry for ten and twenty days seems to decrease the mean incubation period needed for hatching when the eggs are returned to moist conditions (i.e. it tends to break diapause). Keeping non-diapause eggs dry for periods of two to 16 days delayed hatching by approximately the time for which the eggs were kept dry, but seemed to have little effect on the viability of the eggs.

6. Chilling diapause eggs for periods of 32 and 70 minutes destroys most of the eggs. Chilling the eggs for 16 minutes does not seem to significantly affect their viability or their rate of hatching.

III. PLANT PHYSIOLOGY

Two main lines of investigation have occupied the Plant Physiology group during 1962. One of these dealt with preliminary attempts to characterize the naturally-occurring gibberellins of sugar cane, and a second with the inter-relationships between foliar diagnosis, amounts of fertilizers applied to a given soil, and final yields of cane, sugar, and raw cane-juice ratios.

A. Gibberellin-like Substances in Sugarcane

Preliminary experiments have indicated that gibberellin-like substances occur in the shoots of sugar cane, but not in the roots. The chromatographic behaviour of one of the gibberellin-like materials in the shoots resembled GA_2 , but further work is needed to confirm this. An interesting result of the preliminary experiments was the demonstration of the specificity of the bioassay method which is employed to detect gibberellin-like activity. The rice seedling assay, for example, indicated the presence of a growth inhibitor, at Rf O.O.—O.2, in shoots, while the oat first-internode assay detected stimulation of growth by eluates from the same Rf value. Inhibitory substances were found in 42 and 56-day old tissues, but not in 14-day old material. Further studies on the naturally-occurring gibberellins of sugar cane will be continued by Dr. B.H. Most, who plans to apply to the problem the techniques of thin-layer chromatography, coupled with a number of sensitive colorimetric and bioassay methods.

B. Foliar Diagnosis as a Guide to the Mineral Nutrition of Sugar Cane in Trinidad

The practical aim of foliar diagnosis is to determine the nutritional status of a crop at various periods during its growth, to remedy deficiencies as they occur, and thereby to improve final yields. Before the technique may be applied with precision on a field scale, it is vital to know whether inter-relationships exist between the amount of fertilizer applied to the crop, the content of major (or minor) elements in tissues of the crop at given times after the fertilizer is applied, and the final yields, expressed as tons sugar per acre or tons raw cane per ton sugar. In Trinidad, a foliar index value for N, P, or K had not previously been established. During the year, leaves were collected from plants growing in plots of 3 x 3 x 3 factorial experiments, and N, P, K analyses were completed at from 3 to 7 months. The following table summarizes those leaf values (highest visible dewlap) for N, P, and K in ratoons at 4 months which were associated with maximum yields of sugar per acre.

Soil Type	Percent of Element in Highest Visible Dewlap at 4 months of Age (Ratoons)		
	Nitrogen	Phosphorus	Potassium
Mc Bean sand and loam	2.4—3.3	0.29—0.43	1.9—2.1
Freeport clay (Wyaby)	2.7—3.2	0.28—0.30	1.0—1.3
Freeport clay (Waterloo)	2.6—3.0	0.28—0.30	1.7—1.9
Piarco Series (Monjaloux)	1.7—2.0	0.20—0.23	1.1—1.2
Bejucal very heavy clay (Felicite)	1.7—2.8	0.29—0.32	1.3—1.7
Cunupia medium clay	2.5—2.7	0.26—0.27	1.5—1.6

Of particular interest is the fact that the leaf values, considered adequate for maximum yields, vary according to the soil type on which the cane was grown. For example on Freeport Clay,

at two different locations, maximum yields were associated with 2.6 to 3.2 per cent nitrogen in the four month-old leaf, while on the Piarco series, or on Bejucal very heavy clay, 1.7 to 2.8 per cent leaf N was adequate for the maximum tons sugar per acre. In general the leaf index values for N, P, and K reflected the quantity of fertilizer which had been applied earlier to the plots in which the plants were growing.

IV. MICROBIOLOGY

A quantitative study of the microflora in three different types of "sugarcane" soils revealed marked fluctuations in numbers of bacteria, fungi, and streptomycetes depending upon the type of soil and moisture content.

In soils containing a relatively high proportion of clay, microbial counts increased with the onset of the rainy season and decreased when the soils became saturated. When the heavy clay soils contained less moisture, microbial counts again increased. In a sandy loam soil the peaks in microbial numbers occurred much later in the year than in the heavy clays, presumably because the lighter soils drained more freely and dried more quickly than the clays.

With the information which has now been gathered on the quantitative changes in microbial populations in different types of soil it should be possible to design, more accurately, experiments to evaluate the role of the rhizosphere on cane growth and on the development of the root system.

STAFF PUBLICATIONS

I. Plant Physiology

1. VLITOS, A.J. "Plant Growth Regulators." in International Symposium on Food Additives, Iowa State University Press 1962 (in press).
2. CUTLER, H.G., and VLITOS, A.J. The natural auxins of the sugarcane. I.S.S.C.T. Proceedings 1962 (in press).
3. VLITOS, A.J. and LAWRIE, I.D. Foliar diagnosis as a guide to the mineral nutrition of sugarcane in Trinidad. Trop. Agri. (in press).
4. HERRETT, RICHARD A., HATFIELD, H.H., CROSBY, D.G., and VLITOS, A.J. Leaf abscission induced by the iodide ion. Plant Physiology 37: 358. 1962.

II. Agronomy

1. LAWRIE, I.D. and VLITOS, A.J. Chemical weed control in Trinidad sugar cane I.S.S.C.T. Proceedings 1962 (in press).

III. Entomology

1. FEWKES, D.W., MERRY, C.A.F., and VLITOS, A.J. Newer insecticides for the control of the sugarcane froghopper (*Aeneolamia varia saccharina* Distant) I.S.S.C.T. Proceedings (in press).

Scientific Meetings, Conferences, and Visits

(1) The Director of Research was invited to present a paper on "Plant Growth Regulators as Incidental Food Additives" at an International Conference on Food Protection, sponsored by the U.S. National Institutes of Health, Iowa State University, 9th—12th May, 1962. He also visited the Agricultural Chemicals group of E.I. du Pont de Nemours at Wilmington, Delaware on 14th May, 1962.

(2) The Entomologist and the Director of Research attended the I.S.S.C.T. Conference in Mauritius from 22nd September to 7th October, 1962. Following the Conference, the Entomologist visited several sugar cane areas in Natal. The Director of Research visited the Chirundu Sugar Estates, Southern Rhodesia in October. En route from Mauritius to Trinidad he also spent one week in London and visited the Tate and Lyle Ravensbourne Laboratories and the British Sugar Corporation Laboratory in Peterborough.

(3) In July, the Director of Research was invited to attend the International Conference on Neo-Tropical Botany held at the University of the West Indies in Trinidad.

(4) In December the Director of Research attended, in Puerto Rico, a Symposium sponsored by Esso Standard Oil S.A. Ltd., on the chemical regulation of sugarcane ripening. He also took part in the annual meeting of the Cane Breeding Station Technical Advisory Committee held in Barbados on 11th December, 1962.

I. AGRONOMY

A. Selection of New Varieties

1. Performance of Standard Varieties on a Field Scale at Ste. Madeleine

F.B. Little
E.M. Johnson

The varietal position at Ste. Madeleine has changed rapidly over the past five years. An examination of Table 1 will show that, whereas B 49119 and B 50112 were planted on a rela-

tively insignificant proportion of the acreage during 1958 and 1959, these two varieties represented 39% and 35%, respectively, of the plant cane acreage during 1962.

Table 1.
*Changes in Varieties Planted at Ste. Madeleine
during the period 1958 to 1962*

Variety	1958		1959		1960		1961		1962	
	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%
B 49119	—	—	68	1½	1027	22	1540	36	1566	39
B 50112	—	—	13	½	122	3	892	21	1386	35
B 41227	28	1	272	6	183	4	119	3	779	19
B 45224	1245	29	919	20	534	11	217	5	21	1
B 37161	832	19	595	13	604	13	518	12	8	—
B 37172	1465	34	1646	36	860	19	486	12	—	—
Others	749	17	1067	23	1305	28	452	11	236	6
Total	4319	100	4580	100	4635	100	4224	100	3996	100

In view of the rapid extension of B 49119 and B 50112, it was important to assess the relative merits of the two varieties and to compare their productiveness on a field-scale with that of the older standards (i.e. B 37161 and B 37172). Comparisons of B 49119 and B 50112 with B 41227, B 4362, and B 45224 were also required. We are indebted to Messrs. Potter, Massiah, Taylor, and Nichols who collaborated

to coordinate the following, exhaustive large-scale evaluation of B 49119, B 37161, B 37172, B 50112, and B 41227 (Tables 2 to 6). The data were obtained during the 1962 crop.

During the 1962 crop B 49119 produced, on the average, over 5 tons more cane per acre than B 41227 and over 7 tons more cane per acre than B 37161 and B 37172 (Table 2).

Table 2.

Acres reaped and tons cane per acre for six major cane varieties (Crop 1962—Ste. Madeleine)

Variety	Acres Reaped	TC/A	TC/A Per Cent of Standard B 37161	TC/A Per Cent of Standard B 37172
B 49119	2401	30.40	129	134
B 50112	776	27.92	118	123
B 41227	460	24.98	106	110
B 45224	2239	27.04	115	119
B 37161	2353	23.61	100	104
B 37172	3659	22.74	96	100

A summary of the sugar yields per acre, obtained from 10 and 100 ton samples of the varieties under examination, is presented in Table 3.

Table 3

Summary of Sugar Yields — Varieties B 37161, B 37172, B 41227, and B 49119 (Reform Factory Data)

Variety	Tons Sugar Per Acre		
	Young Plants	Ratoons	
	10 ton samples	100 ton samples	10 ton samples
B 37161	2.28	2.34	2.59
B 37172	2.54	2.71	2.16
B 41227	2.82	2.97	2.75
B 49119	3.18	3.44	3.48

B 49119 averaged 0.36 to 0.71 tons more sugar per acre than B 41227, 0.89 to 1.10 tons more sugar per acre than B 37161, and .56 to 1.32 tons more sugar per acre than B 37172. B 41227 outyielded B 37161 and B 37172.

The "pre-processing cost per ton of sugar" for each variety is presented in Table 4. "Pre-

processing costs" were obtained by applying the Fairrie formula, $R \left(\frac{C}{Y} + H \right) = \text{pre-processing cost}$; where $R = TC/TS$, $Y = \text{yields of cane in tons per acre}$, $H = \text{harvesting costs per ton cane}$, and $C = \text{overall cultivation costs per acre}$. In the present case the harvesting cost per ton (H) is given as \$7.20 (B.W.I.) and the overall cultivation costs per acre (C) as \$240.00 (B.W.I.). Although these values are probably much higher than the actual, this does not detract from the relative performance of each variety. An examination of Table 4 shows that as young plant canes B 4362 (\$136.78) and B 49119 (\$138.06) were the most efficient sugar producers. As ratoons, B 49119 (\$132.41) and B 3337 (\$133.11) were outstanding. On the other hand, B 50112 was a relatively "expensive" variety to grow, giving pre-processing costs of \$155.73 as plant cane and \$160.75 as ratoons. Similarly B 41227 (\$145.93 as plants and \$155.49 as ratoons) did not match pre-process costs of B 49119, B 4362, or B 3337. It should be kept in mind that pre-processing costs, although they are a valuable guide in assessing the economic performance of a variety for any one year, do not take into consideration ratooning capabilities and other agronomic criteria which might influence overall cultivation costs over a longer period. For example, B 50112, a rapidly growing variety, "closes-in" quickly and thereby may reduce costs of weeding. Pre-processing costs place a premium on sucrose content, and at present this criterion seems the most logical one on which to base the selection and extension of newer varieties, so long as cane yields per acre remain reasonably high.

Table 4.
Summary of Field and Factory Data from '10' ton
Sampling of Varieties — Crop 1962

Variety	Young Plants					Ratoons				
	No. of Samples	TC/A	TC/TS	TS/A	Pre- processing cost per ton sugar	No. of Samples	TC/A	TC/TS	TS/A	Pre- processing cost per ton sugar
B 37161	6	19.59	8.59	2.28	\$167.07	20	22.86	8.83	2.59	\$156.29
B 37172	3	20.84	8.20	2.54	\$155.06	35	20.38	9.44	2.16	\$179.07
B 41227	3	23.83	8.45	2.82	\$145.93	23	26.03	9.47	2.75	\$155.49
B 49119	23	27.66	8.70	3.18	\$138.06	19	30.65	8.81	3.48	\$132.41
B 50112	11	27.44	9.77	2.81	\$155.73	6	28.04	10.20	2.75	\$160.75
B 45224	5	22.18	10.36	2.14	\$186.68	32	26.99	10.88	2.48	\$175.06
B 3337	—	—	—	—	—	8	27.32	8.33	3.28	\$133.11
B 4362	3	28.40	8.74	3.25	\$136.78	5	26.19	9.32	2.81	\$152.47
B 45152	—	—	—	—	—	2	23.29	8.26	2.82	\$144.55
B 46378	—	—	—	—	—	3	30.02	9.78	3.07	\$148.56
B 4744	—	—	—	—	—	15	23.07	9.78	2.36	\$172.13
B 4747	1	22.91	8.95	2.56	\$158.24	17	27.21	9.29	2.93	\$148.82
B 48228	—	—	—	—	—	6	37.77	10.79	3.50	\$146.20
B 48231	—	—	—	—	—	4	33.20	11.25	2.95	\$162.34

In general, the milling qualities of the varieties in question were satisfactory (Table 5). There was one adverse report for B 50112 (choking

of the mills). B 49119 was noted to split longitudinally after initial preparation by the knives, but this was not considered too serious.

Table 5.
Data from Factory Testing of '100 ton' Samples of Plant Cane at Reform Factory and Ste. Madeleine—Crop 1962
Varieties B 37161, B 37172, B 41227, B 49119, and B 50112

Variety	Field	1st Expressed Juice		Mixed Juice		Bagasse		Cane		Tons cane per hour	Galls. Juice per ton cane	Tons cane Ground	Tons cane per ton 96° sugar	Tons 96° sugar made	Remarks
		Brix	Purity	Brix	Purity	% Pol	% Moisture	% Pol	% Fibre						
B 37161	BL. Sav.	20.63	86.13	15.88	83.38	3.58	48.80	14.52	9.78	39.64	168.42	109.00	7.73	14.10	Milling, Boilers, and boiling house satisfactory
„	CH. 34A	20.05	84.49	15.07	81.95	3.13	49.00	13.29	11.90	34.58	160.74	102.00	8.59	11.87	„ „ „ „ „ „
B 37172	H. 12	21.40	84.30	16.00	82.81	3.45	51.00	13.61	12.61	91.00		79.70	8.29	9.61	Test at Ste. Madeleine—Everything satisfactory
„	BL. 7/8	18.76	84.49	14.69	81.42	2.71	47.68	12.48	12.48	36.28	163.18	36.28	9.14	3.97	Milling, boilers, and boiling house satisfactory
„	BL. 23	20.26	86.03	16.38	83.09	3.54	48.30	14.18	10.50	36.08	167.84	92.00	7.81	11.78	„ „ „ „ „ „
B 41227	Ref. 57	19.78	86.05	15.47	83.71	3.71	46.75	13.20	13.14	37.41	160.43	101.00	8.71	11.60	„ „ „ „ „ „
„	BL. 30	20.43	85.85	16.54	84.16	3.62	52.00	14.57	9.89	37.89	164.43	108.00	7.71	14.01	„ „ „ „ „ „
B 49119	Brs. 70	21.00	86.62	16.05	83.61	3.85	46.64	15.49	10.11	39.59	167.15	104.91	7.62	13.77	„ „ „ „ „ „
„	SL. 13	20.39	83.32	15.60	80.06	2.78	48.80	12.80	12.88	37.73	155.35	103.00	9.04	11.39	„ „ „ „ „ „
„	BL. 5	19.57	85.64	15.13	83.48	2.84	51.37	14.05	8.24	35.08	174.71	107.00	7.86	13.61	„ „ „ „ „ „
„	SL. 20	19.90	82.56	16.07	80.27	3.10	47.59	14.32	11.19	37.86	168.38	106.00	8.50	12.47	„ „ „ „ „ „
B 50112	Mt. 14/15	19.55	79.28	15.22	76.67	2.67	45.40	12.28	10.76	38.74	168.54	98.00	9.31	10.53	„ „ „ „ „ „
„	Ref. 35	17.96	80.73	13.61	78.60	2.99	48.30	11.18	14.01	35.13	154.95	106.08	10.67	9.94	„ „ „ „ „ „
„	Brs. 61	19.73	80.03	15.69	78.11	3.73	48.14	12.51	13.86	39.70	155.25	105.21	9.65	10.90	„ „ „ „ „ „
„	Af. 11	19.40	82.42	14.82	80.63	3.02	52.80	12.78	10.55	36.45	162.66	74.00	9.00	8.22	„ „ „ „ „ „
„	Mt. 11/15	19.84	82.41	14.96	80.35	3.01	49.91	12.99	9.75	37.03	163.67	100.00	8.79	11.38	Slight tendency to choke mills
„	LF. 30	19.30	78.65	15.40	76.34	3.12	49.00	11.87	14.27	97.85		122.31	10.04	12.18	Test at Ste. Madeleine — Everything satisfactory

The cane and sugar yields obtained from 100 ton samples of plant canes of varieties B 37161, B 37172, B 41227, B 49119, and B 50112 are presented in Table 6. Pre-processing costs per ton of sugar were \$129.11 for B 49119, followed by \$139.36 for B 41227, \$148.91 for B 37172, \$151.46 for B 50112, and \$160.67 for B 37161.

Table 6.
Yields and Pre-Process Costs for Plant Fields in Factory Testing
of Varieties '100 ton' Samples — Crop 1962

Variety	Field	Age in Months	Tons Cane per acre	Tons Cane per ton sugar	Tons Sugar per acre	Tons Sugar per acre per month	Pre-process cost per ton sugar \$ BWI
B 37161	BL. Sav.	11	20.88	7.73	2.70	0.25	
B 37161	CH. 34A	11	16.88	8.59	1.97	0.18	
Av. B 37161		11	18.88	8.07	2.34	0.21	\$160.67
B 37172	H. 12	11	26.67	8.29	3.22	0.29	
B 37172	BL. 7/8	9	21.26	9.14	2.33	0.26	
B 37172	BL. 23	10	20.17	7.81	2.58	0.26	
Av. B 37172		10	22.70	8.38	2.71	0.27	\$148.91
B 41227	Ref. 57	11	23.03	8.71	2.64	0.24	
B 41227	BL. 30	11	25.34	7.71	3.29	0.30	
Av. B 41227		11	24.19	8.14	2.97	0.27	\$139.36
B 49119	Brs. 70	11	25.50	7.62	3.35	0.30	
B 49119	SL. 13	10	30.73	9.04	3.40	0.34	
B 49119	BL. 5	10	26.74	7.86	3.40	0.34	
B 49119	SL. 20	11	30.58	8.50	3.60	0.33	
Av. B 49119		10½	28.39	8.25	3.44	0.33	\$129.11
B 50112	Mt. 14/15	10	29.68	9.31	3.19	0.32	
B 50112	Ref. 35	9½	23.21	10.67	2.18	0.23	
B 50112	Brs. 61	10	29.81	9.65	3.09	0.31	
B 50112	AF. 11	9½	19.93	9.00	2.21	0.23	
B 50112	Mt. 11/15	11	29.24	8.79	3.33	0.33	
B 50112	LF. 30	11	34.82	10.04	3.47	0.32	
Av. B 50112		10	27.88	9.58	2.91	0.29	\$151.46

2. Results of Variety Trials

In addition to the field-scale evaluation of varieties at Reform Factory, there were 22 small-scale variety experiments reaped and analyzed at Ste. Madeleine during the year. Detailed results are given in Appendices 1 to 18. The results of four of the trials are incomplete and have not been presented.

On the basis of pre-processing costs per ton sugar, B 55304 and B 5557 were the most promising of the new varieties when reaped as young plants (Appendix 1). If one averages the pre-processing costs as young plants (Appendices 1 to 4) for B 49119, B 50112, B 41227, B 37172 and B 37161 it is found that the relative costs are as follows: B 49119 (\$165.02), B 50112 (\$188.37), B 41227 (\$156.30), B 37172 (\$199.41), and B 37161 (\$223.50). B 55304 in the single trial in which it was evaluated gave a pre-processing cost per ton sugar of \$158.99, while B 5557 cost \$160.44 per ton sugar prior to processing (Appendix 1).

As advanced plants (Appendices 5 and 6) the average pre-processing costs of the standards in small-scale plots were as follows: B 49119 (\$123.20), B 50112 (\$114.30), B 41227 (\$144.31), B 37172 (\$151.43), and B 37161 (\$137.04). In preliminary field trials, B 54262 at \$104.44 was a marked improvement over the standards (Appendix 5). B 5449 at \$118.40 and B 54142 at \$119.08 also show promise and will be included in additional experiments.

In trials which were reaped as first ratoons (Appendices 7 and 8) B 50112 averaged the lowest pre-processing cost per ton sugar (i.e. \$133.42), as opposed to \$135.49 for B 49119, \$140.85 for B 41227, \$174.92 for B 37172, and \$173.38 for B 37161. Of the experimental varieties B 51167 at \$135.39 (Appendix 7) and B 52316 (Appendix 8) at \$119.17 compared favourably with the standards.

In trials reaped as second ratoons (Appendices 9 to 15), B 41227 averaged the lowest pre-

processing cost per ton sugar (i.e. \$141.43), (\$160.73), B 37172 (\$168.04), and B 37161 (\$166.18) proved to be relatively inefficient sugar producers in the majority tests reaped as second ratoons. Of the experimental varieties, B 48372 (Appendices 9, 10, 11, 12 and 13) compared favourably with the standards, averaging \$133.49 pre-processing costs per ton sugar.

As third ratoons (Appendices 16 to 18) B 37161 and B 37172 averaged \$155.34 and \$152.87 pre-processing costs per ton sugar, respectively, compared with \$128.34 for B 46102 and \$132.87 for B 47204.

Summarized below are the average pre-processing costs for the standard varieties from all trials which were reaped during 1962 (plants and ratoons inclusive) :

B 49119	=	\$141.75
B 41227	=	\$145.72
B 50112	=	\$149.21
B 37172	=	\$173.45
B 37161	=	\$175.03

It would appear that B 49119, B 41227, and B 50112, the three varieties which have been replacing B 37161 and B 37172 on the Estates should eventually account for appreciable savings. It is of particular interest that B 50112 averaged its lowest pre-processing cost per ton sugar as advanced plants (Appendices 5 and 6), and its highest pre-processing costs (i.e. \$188.37) as young plants (Appendices 1, 2, 3, and 4). B 41227, of the standards, averaged its lowest pre-processing costs when reaped as young plants (Appendix 1). The following data summarizes the average pre-processing costs for the standard varieties reaped as young plants, advanced plants, and as first and second ratoons :

As Young Plants

	B 49119	B 50112	B 41227	B 37172	B 37161
Pre-processing cost per ton sugar	\$165.02	\$188.37	\$156.30	\$199.41	\$223.50

As Advanced Plants

	B 49119	B 50112	B 41227	B 37172	B 37161
Pre-processing cost per ton sugar	\$123.20	\$114.30	\$144.31	\$151.43	\$137.04

1st Ratoons

	B 49119	B 50112	B 41227	B 37172	B 37161
Pre-processing cost per ton sugar	\$135.49	\$133.42	\$140.85	\$174.92	\$173.38

2nd Ratoons

	B 49119	B 50112	B 41227	B 37172	B 37161
Pre-processing cost per ton sugar	\$143.28	\$160.73	\$141.43	\$168.04	\$166.18

On the basis of the experimental results at Ste. Madeleine it is highly recommended that further extension of B 49119 and B 41227 continue. The large-scale factory data, coupled with the results from an extensive number of variety trials, support the conclusion that B 49119, of the major varieties presently in cultivation at Ste. Madeleine averages the lowest pre-processing cost per ton of sugar. B 50112, judging from the factory data, should not be

extended very much beyond its present acreage. In the small-scale variety trials, B 50112 averaged its highest pre-processing costs as second ratoons, but was an efficient sugar producer as advanced plants. It is necessary to conduct large-scale factory analyses of the variety during the 1963 crop before extending it to greater acreages.

Of the newer varieties, B 55304, B 5557, B 54262, B 5449 and B 54142 are to be included in further trials.

3. Selection of New Varieties at Caroni Limited

I. D. Lawrie

During the year, two sorting trials and twelve continuation trials were reaped and analyzed at Caroni Limited.

The two sorting trials of the Barbados 54' and 55' series, were reaped as first ratoons. Of the B 54' series B 5401 shows continued promise, for apart from outyielding the standard for the second successive year, it possesses very good juice quality. In addition, B 54227 has performed extremely well as 1st ratoons, outyielding the standard B 41227, by 0.35 TS/A (Appendix 32). Of the B 55' series, B 5557 has outyielded the standard, B 41227, for the second successive year, and continues to be the most promising variety of the B 55' series (Appendix 31).

The outstanding feature of the continuation trials is the superior juice quality of B 49119, as compared with B 41227. Of the 12 trials in which both these varieties were included, the juice quality of B 49119 was better than B 41227 in 11, of which the differences were statistically significant in six. (Appendices 19, 23, 24, 25, 26, and 27). However, the yields of B 49119 were very disappointing as first ratoons, being 91.6% of the standard B 41227.

The 'Pre-process cost', as derived from the Fairrie formula $R (\frac{C}{Y} + H)$,* for comparison of agricultural performances, has been calculated for varieties B 41227, B 49119 and B 50112. A summary of the data is presented below :

Pre-processing Costs Per Ton Sugar										
Variety	No. of Trials	Plants	No. of Trials	1st Ratoons	No. of Trials	2nd Ratoons	No. of Trials	3rd Ratoons	No. of Trials	4th Ratoons
B 41227	—	—	5	\$113.60	5	\$184.75	3	\$153.17	1	\$164.83
B 49119	—	—	5	\$118.13	5	\$139.49	1	\$126.58	1	\$161.95
B 50112	—	—	5	\$126.53	1	\$128.02	2	\$153.74	—	—

On the basis of 'Pre-process costs', B 49119 is the outstanding variety of the three listed above, when considered as 1st, 2nd, 3rd, and 4th ratoons. Unfortunately, the 'pre-process costs' for assessing the merits of different varieties does not take into account ratooning ability, nor does it measure other agronomic characters which might influence overall cultivation costs (i.e. rapidity of closing-in and weeding costs, etc.). Nevertheless the formula does provide an economic assessment; something which has been lacking in previous research reports.

B 5121 has not maintained its promise of last year. B 50135 and B 51353 were very disappointing. They did not match the yields of B 41227 in any of the trials in which they were included. The Hawaiian varieties also performed

very poorly under Trinidad conditions.

The B 56', B 57', Hawaiian, Mauritian and Australian varieties, which were multiplied last year, have been placed into two sorting trials. Planting material of these have also been supplied to Ste. Madeleine. The B 58' and B 59' varieties, which were established in multiplication plots last year, have been further multiplied and will be placed into trials next year. Those varieties of the B 58' series which did not germinate in C.A.R.S. plots have been requested from Centeno. Also 5 of the B 59' series which did not germinate last year have been requested from Barbados. The detailed results and analyses from all variety trials reaped during 1962 crop are presented in Appendices 19 to 32.

B. Insecticides (for Control of *Aeneolamia varia saccharina* Distant)

1. At Caroni Limited

I. D. Lawrie

During 1962 several new insecticides were screened for froghopper nymph control at Caroni Limited. The newer insecticides were compared with Trithion (granular or dust formulation) or with Thimet granular. In addition, Sevin, DDT,

and Dieldrin were re-evaluated during the year. A list of the compounds which were included in the trials is presented in Table 1, along with the rates of application, trade names, source of supply, and toxicity.

* Where $R = TC/TS$, C=Cultivation costs per acre, $Y = TC/A$ and $H = \text{Harvesting costs per ton sugar}$. ($C = \$240 \text{ B.W.I.}$ and $H = \$7.20$).

Table 1.

Manufacturer	Product	Chemical Composition	lbs. or % active	Rates tested at per acre	Toxicity	
					Oral mg/kg.	Dermal mg/kg.
E.I. du Pont de Nemours (U.S.A.)	Marlate	Methoxychlor	50% W.P.	5 and 10 lbs.	6000	> 2820
"	Marlate 2MR	24% Methoxychlor = 21% 2,2-bis (p-methoxyphenyl) 1,1,1-trichloroethane and 3% other isomers and reaction products	2lbs/gall. U.S.	2 and 4 lbs.	6000	> 2820
"	EPN	Ethyl p-nitro-phenyl thiono benzene phosphonate	4 lbs/gall. U.S.	1 and 3 lbs.	35—45	30—50
Stauffer Chemical Co. (U.S.A.)	Imidan	Phthalimido methyl-O, O-dimethyl phosphorodithioate	10% Granular 3lbs/U.S. gall. E.C.	4 and 6 lbs. 4 and 6 lbs.	147	3160
"	Trithion	O, O-diethyl S-p-chlorophenyl thiomethyl phosphorodithioate	10% Granular 25% D.B.	4 lbs. 6 lbs.	10—30	800
Fisons Pest Control Ltd. (U.K.)	Basudin	O, O-Diethyl-O-(2-Isopropyl-4-Methyl- pyrimidinyl (6)) thiophosphate	10% Granular	8 lbs.	300—400	1000
Bayer Leverkusen (Germany)	Metasystox R	Dimethyl ethylsulphoxyethyl thiophosphate	25% E.C.	16 fl. oz. and 24 fl. oz. and ½ and 1 gallon	50—75	300—400
"	Folidol	Dimethyl paranitrophenyl thiophosphate	40% E.C.	5 and 10 lbs.	9—18	750—2000
"	Dipterex	Dimethyl trichlorohydroxy ethyl phosphonate	80% W.P.	2.4 and 4.8 lbs	650	2800
"	Lebaycid	Dimethyl-methyl mercapto methyl phenyl thiophosphate	3% D.B.	2 lbs.	190—310	330—500
"	"	"	40% W.P.	2 and 4 lbs.	190—310	330—500
"	"	"	50% E.C.	2 and 4 lbs.	190—310	330—500
"	Disyston	O,O-Diethyl S-2 (ethylthio) ethyl phosphorodithioate	5% Granular	2, 3 and 4 lbs.	12.5	20
Shell (Trinidad) Limited	SD 3562	3- (Dimethoxyphosphinyloxy)-N, N dimethylcrotonamide	7.5 lb/gall.	2 and 4 lbs.	27	112
"	Dieldrin	1,2,3,4,10,10-hexachloro- <i>exo</i> -6, 7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1, 4-endo, <i>exo</i> -4, 8 dimethanonaphthalene	50% W.P.	10 lbs.	40	100
S.B. Penick & Co. (U.S.A.)	Anti-resistant DDT	Dichloro-diphenyl-trichloro-ethane + (N,N- dibutyl-P-chlorobenzenesulfonamide)	50% W.P.	10 lbs.	300	—
Geigy Agricultural Chemicals (U.S.A.)	DDT	Dichloro-diphenyl-trichloroethane	50% W.P.	6.7 and 10 lbs.	300	—
American Cyanamid (U.S.A.)	Thimet	O, O-diethyl S-(ethyl thiomethyl) phosphorodithioate	10% Granular	2 lbs.	3.7	270—1460
Esso Standard Oil (U.S.A.)	Agricultural Mulch	—	—	400 gal.	—	—
	Mulch + Trithion	—	6%/600 gall.	4 lbs.	—	—
	Mulch + DDT	—	10%/600 gall.	6.7 lbs.	—	—
Hoechst (Germany)	Thiodan	6,7,8,9,10,10-Hexachloro-1,5,5a,6,9, 9a-hexahydro-6,9:methano-2, 4,3-benzodioxathiepine 3-oxide	35% W.P. and 35% E.C.	8.4 lbs and 11.2 lbs.	110	359
Union Carbide (U.S.A.)	Sevin	1-Naphthyl N-methyl carbamate	18% Granular	6 lbs. and 8 lbs.	500—700	—
"	U.C. 16888	?	4 lbs/U.S. gall.	1.5 and 3 lbs.	100	300
Rohm & Haas (U.S.A.)	Rhothane	Diethyl diphenyl dichloroethane	50% W.P.	3, 6 and 9 lbs.	—	?
"	Perthane	Diethyl diphenyl dichloroethane	45% E.C.	1, 2 and 4 lbs.	—	?

Materials, Methods, and Experimental Design

The insecticides under test were subjected to a particularly severe environment as the result of a new design which enabled each insecticide-treated plot to be completely surrounded by an untreated area. Continuous migration of frog-hoppers from untreated to treated plots was thereby facilitated. A diagram of the plot design, arranged either as latin squares or randomized blocks, is presented below:

	C		D
B		A	
	D		E
A		C	
	E		B

Plots were 1/40th acre, with the exception of the trials reported in Tables 9 and 12 which consisted of 1/400th and 1/80th acre, respectively.

Dust and wettable powder formulations were diluted with ground limestone and applied at 2½ to 3 cwt. per acre by means of hand-operated rotary dusters. Granular formulations were applied with Torpille granular applicators. Liquid sprays were applied with knapsack sprayers.

Nymph counts were taken before, and at periodic intervals after, application of insecticides. The nymphs occurring about the base of four sugar cane stools, chosen at random, were counted at each date of sampling. In the trial with "agricultural mulch", counts were taken of those nymphs occurring at the base of four "marked" stools chosen at random.

Results

Detailed data are presented in Tables 2 to 13. Some of the results are presented graphically, wherever it facilitates interpretation of the data.

a. Chlorinated Hydrocarbons

Seven chlorinated hydrocarbons were included in the trials. These were Dieldrin, DDT, "Anti-resistant" DDT, Marlate, Marlate 2MR, Rhothane, and Perthane.

DDT gave a typical pattern of very slow initial kill followed by prolonged residual activity. The residual control of frog hopper nymphs by DDT was as effective as Trithion granular in one trial (Fig. 1, Table 2). Unfortunately, in a second experiment, very low nymph counts were recorded in the control. Nevertheless, lengthier residual activity was obtained from 10 lbs. active DDT per acre than from Thimet at 2 lbs. active per acre (Table 8).

Anti-resistant DDT gave results comparable to those of DDT (Fig. 1 and Tables 2 and 8).

Dieldrin gave a more rapid initial kill of nymphs than either DDT, anti-resistant DDT, or Trithion granular. However, the persistence of Dieldrin was not as prolonged as either DDT or anti-resistant DDT (Fig. 1 and Tables 2 and 8).

Marlate was ineffective in controlling nymphs, even at rates of 10 lb. active per acre (Table 5).

Marlate 2MR provided an initial kill of frog-hopper nymphs, followed by relatively short residual control (Table 6).

Both Rhothane and Perthane were ineffective in controlling frog hopper nymphs at the rates tested (Table 12).

b. Organophosphates

Ten organophosphorus compounds, in different forms, were evaluated against frog hopper nymphs in the 1962 trials. The compounds tested were Lebaycid, Metasystox R, Folidol, Dipterex, EPN, Imidan, Trithion, Basudin, Thimet, and Disyston.

Lebaycid was evaluated as a dust, as a wettable powder, and as an emulsifiable concentrate.

The three types of formulations provided a quick initial kill of frog hopper nymphs but residual control was variable (Tables 4, 7, and 11, and Fig. 2).

At equivalent rates of applications (i.e. 2 lbs. active ingredient per acre), the dust formulation provided approximately seven weeks' control,

while the emulsifiable concentrate controlled nymphs for about five weeks. The trial evaluating the wettable powder formulation is still in progress.

Metasystox R at the lower rates of application was ineffective in controlling froghopper nymphs (Table 4). However at the highest rate used (1.0 gallon per acre), there was a quick kill of nymphs but poor residual control (Table 11). It is quite possible, judging from results at Ste. Madeleine, that at higher rates of application *Metasystox R* might perform more effectively.

Folidol, Dipterex and Shell SD 3562 :

Dipterex gave a rapid initial kill followed by poor residual control.

Both Folidol and Shell SD 3562 provided an extremely quick kill followed by excellent residual control of nymphs when applied as emulsifiable concentrates in 60 gallons of water (Fig. 3, and Table 10).

Imidan was evaluated in two trials at 4 and 6 lbs. active per acre. Residual control was obtained to approximately five weeks with both rates of application. The initial kill provided by *Imidan* was variable (Tables 5 and 6).

EPN was tested at 1 and 3 lbs. active per acre as an emulsifiable concentrate, applied in 80 gallons of water per acre. The chemical gave a slow initial kill, followed by prolonged residual control, of froghopper nymphs. Residual effects were noted for eight weeks at the higher rate of application (Table 6). The mode of action of *EPN* resembles that of *Trithion*, particularly with respect to the slow initial destruction of nymphs but prolonged residual effectiveness.

Trithion was used in most trials as a standard. The granular formulation was used in all the early trials, since this was the normal Estate practice at Caroni Limited at that time. All the trials were trashed prior to application of the treatments. The results were extremely disappointing. Initial kill was extremely slow and residual control was poor. (Tables 2, 3, 5, 7, and Fig. 1 and 2).

The dust formulation of *Trithion* gave a more rapid initial kill of froghopper nymphs than the granular formulation (Tables 12 and 13). Unfortunately, the dust formulation was employed in trials which were laid out late in the season, and therefore it is too early, at the time

of writing, to report on residual effectiveness. The trials are being continued.

Basudin (Diazinon) was evaluated in one trial (Table 5) at 8 lbs. active per acre. A quick initial kill was followed by residual control of froghopper nymphs, comparable to that given by *Trithion*.

Disyston is being evaluated at 2, 3, and 4 lbs. active per acre as a 5% granular formulation, and compared with *Thimet* at 2 lb. per acre and *Trithion* as a 2% dust formulation. Twelve days after application approximately the same degree of control has been recorded with the different rates of the three insecticides (Table 12). The trial is being continued.

c. Other Insecticides

The insecticides included in this group may be divided into four sub-groups :

- A. *Sevin*
- B. *Thiodan*
- C. U.C. 16888
- D. Agricultural mulches with and without insecticides.

Sevin has been re-evaluated this year as an 18% granular formulation, and has been tested at 6 and 8 lb. active per acre for control of the froghopper nymphs. A reasonably quick initial kill of nymphs was recorded at both rates. However, the residual activity appears to be restricted to 5 to 6 weeks for both the 6 and 8 lb. rates (Table 3).

Thiodan is a chlorinated hydrocarbon containing sulphur. A 35% W.P. formulation of the chemical was evaluated at 3%, and 4%, diluted with ground limestone and applied at 2½ cwt. per acre. Excellent control of froghopper nymphs has been noted from both rates of application. Residual control of nymphs for nine weeks has already been recorded. (Table 7, Fig. 2, and Table 10, Fig. 3).

U.C. 16888 : The chemical formula of this compound has not been revealed and it is therefore being tested under code. It is being evaluated

at 1½ and 3 lbs. active per acre applied in 60 gallons of water per acre.

A trial has been in progress for 14 days, and consequently little can be derived from the results to date, other than the fact that U.C. 16888 does provide a quick kill of frog hopper nymphs (Table 12). The trial is being continued.

Agricultural Mulches. An Esso agricultural mulch applied at 400 gallons per acre, was ineffective in controlling frog hopper nymphs. The mixtures of a) mulch and Trithion and b) mulch and DDT were not as effective as either DDT or Trithion applied without mulch. (Table 9).

Table 2.

A Comparison of DDT, Anti-resistant DDT, and Dieldrin with Trithion (Gran.) for Control of Frog hopper Nymphs

<i>Section :</i>	Washington	<i>Date of Application :</i>	9/8/62
<i>Field :</i>	I C	<i>Rotation :</i>	4th Ratoons
<i>Variety :</i>	B 41227	<i>Experimental Design :</i>	5 x 5 Latin Square
<i>Soil Type :</i>	Washington Clay Loam & Light Clay	<i>Plot Size :</i>	1/40th Acre

Results (Nymphs per Stool)

		Control	Anti-resistant		Dieldrin 10 lbs. act./acre	Trithion (Gran.) 4 lbs. act./acre
No. of Days after Application			DDT 10 lbs. act./acre	DDT 10 lbs. act./acre		
Pre-treatment	8/8/62	23	25	29	20	19
	2	28	23	17	13	17
	7	19	15	15	5	22
	14	17	13	12	2	13
	21	10	4	3	2	8
	27	12	1	0	1	3
	34	17	1	0	1	2
	40	15	2	1	3	7
	48	20	5	3	7	9
	53	26	4	4	14	9
	61	25	5	4	8	7
	68	20	4	3	6	12
	76	12	1	1	8	7

Table 3.

A Comparison of Sevin (Gran.) with Trithion (Gran.) for Control of Froghopper Nymphs

Section: Wyaby Date of Application: 3/8/62
 Field: Est. 27 Rotation: 2nd Ratoons
 Variety: B 41227 Experimental Design: 5 x 5 Latin Square
 Soil Type: Waterloo Loam & Clay Plot Size: 1/40th Acre

Results (Nymphs per Stool)

No. of Days after Application	Control	Trithion (Gran.) 4 lbs. act./acre	Trithion (Gran.) 6 lbs. act./acre	Sevin (Gran.) 6 lbs. act./acre	Sevin (Gran.) 8 lbs. act./acre
Pre-treatment 2/8/62	24	26	27	24	21
4	27	17	14	9	4
11	68	25	21	2	2
18	54	14	6	2	0
25	24	6	8	3	5
32	23	7	6	5	1
39	17	4	3	4	2
46	16	3	2	18	14
53	18	17	5	16	17
61	23	19	14	28	25
67	26	25	26	31	25
74	24	17	13	21	28

Table 4.

A Comparison of Liquid Formulations of Metasystox R with Lebaycid for the Control of Frog hopper Nymphs

<i>Section :</i>	Wyaby	<i>Date of Application :</i>	14/8/62
<i>Field :</i>	C.W. 3	<i>Rotation :</i>	2nd Ratoons
<i>Variety :</i>	B 41227	<i>Experimental Design :</i>	5 x 5 Latin Square
<i>Soil Type :</i>	Freeport Clay	<i>Plot Size :</i>	1/40th Acre

Results (Nymphs per Stool)

	No. of Days after Application	Control	Metasystox R 16 fl. oz./acre	Metasystox R 24 fl. oz./acre	Lebaycid 2 lbs. act./acre	Lebaycid 4 lbs. act./acre
Pre-treatment	13/8/62	64	64	61	57	65
	3	40	40	34	3	2
	7	45	49	25	1	0
	14	36	28	21	0	0
	21	22	11	15	0	0
	28	12	7	5	1	1
	35	10	7	7	7	2
	42	11	10	14	11	6
	50	16	16	14	15	11
	56	15	19	17	14	13
	63	13	14	19	19	14

Treatments were applied in 100 gallons of water per acre.

Table 5.

A Comparison of Marlate, Imidan, and Basudin with Trithion for Control of Froghopper Nymphs

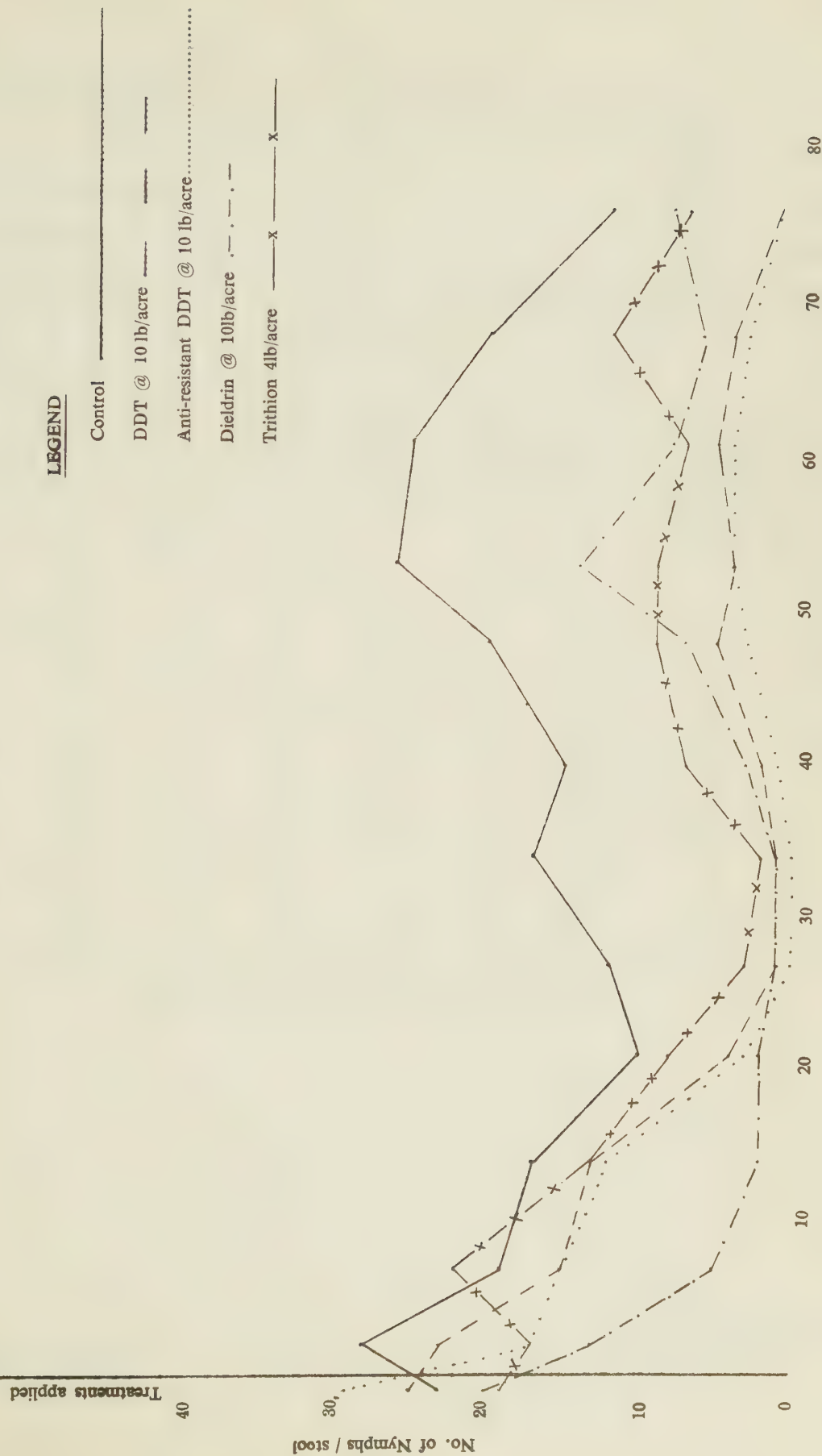
Section: Brechin Castle Date of Application: 18/8/62
 Field: Est. 43 Rotation: 3rd Ratoons
 Variety: B 41227 Experimental Design: 7 x 4 Randomised Blocks
 Soil Type: Cunupia Medium Clay Plot Size: 1/40th Acre

Results (Nymphs per Stool)

No. of Days after Application	Control	Marlate 5 lbs. act./acre	Marlate 10 lbs. act./acre	Imidan 4 lbs. act./acre	Imidan 6 lbs. act./acre	Basudin 8 lbs. act./acre	Trithion 4 lbs. act./acre
Pre-treatment 16/8/62	52	70	65	61	46	61	62
2	45	42	41	25	11	4	32
7	40	39	37	18	3	0	21
16	24	34	23	7	1	0	17
23	14	5	7	3	0	0	9
29	5	4	4	1	0	0	3
36	6	12	6	1	0	4	7
43	22	17	24	18	7	3	9
50	18	19	16	14	8	4	8
57	20	19	15	14	9	7	8
64	9	11	9	13	9	7	9
71	2	4	2	6	2	1	2

FIG 1

A Comparison of D. D. T. Anti-Resistant DDT and Dieldrin with Trithion (Gran.)
for control of Froghopper Nymphs.



No. of Days after Application

Table 6.

A Comparison of EPN, Imidan, and Marlate for Control of Froghopper Nymphs

<i>Section:</i>	Curepe	<i>Date of Application:</i>	23/8/62
<i>Field:</i>	M.P. 45	<i>Rotation:</i>	2nd Ratoons
<i>Variety:</i>	B 41227	<i>Experimental Design:</i>	7 x 4 Randomised Blocks
<i>Soil Type:</i>	Washington Loam & Light Clay	<i>Plot Size:</i>	1/40th Acre

Results (Nymphs per Stool)

	No. of Days after Application	Control	* EPN	* EPN	* Imidan	* Imidan	* Marlate	* Marlate
			1 lb. act./acre	3 lbs. act./acre	4 lbs. act./acre	6 lbs. act./acre	2 MR 2 lbs. act./acre	2 MR 4 lbs act./acre
Pre-treatment	22/8/62	18	17	11	10	13	15	19
	2	9	7	5	2	2	3	6
	7	13	3	2	0	0	5	7
	13	21	1	1	2	0	7	11
	20	15	1	0	0	0	0	4
	26	7	1	0	2	0	2	3
	34	18	5	6	4	4	10	4
	39	26	1	0	14	13	14	8
	47	54	6	2	31	24	11	14
	54	56	10	4	40	36	19	18
	61	46	18	5	24	33	19	28
	68	49	23	10	28	50	40	29

* Treatments applied in 80 gallons of water per acre.

FIG 2

A Comparison of Thiodan, Lebaycid and Basudin with Trithion (Gran.)
for control of Frog hopper Nymphs.

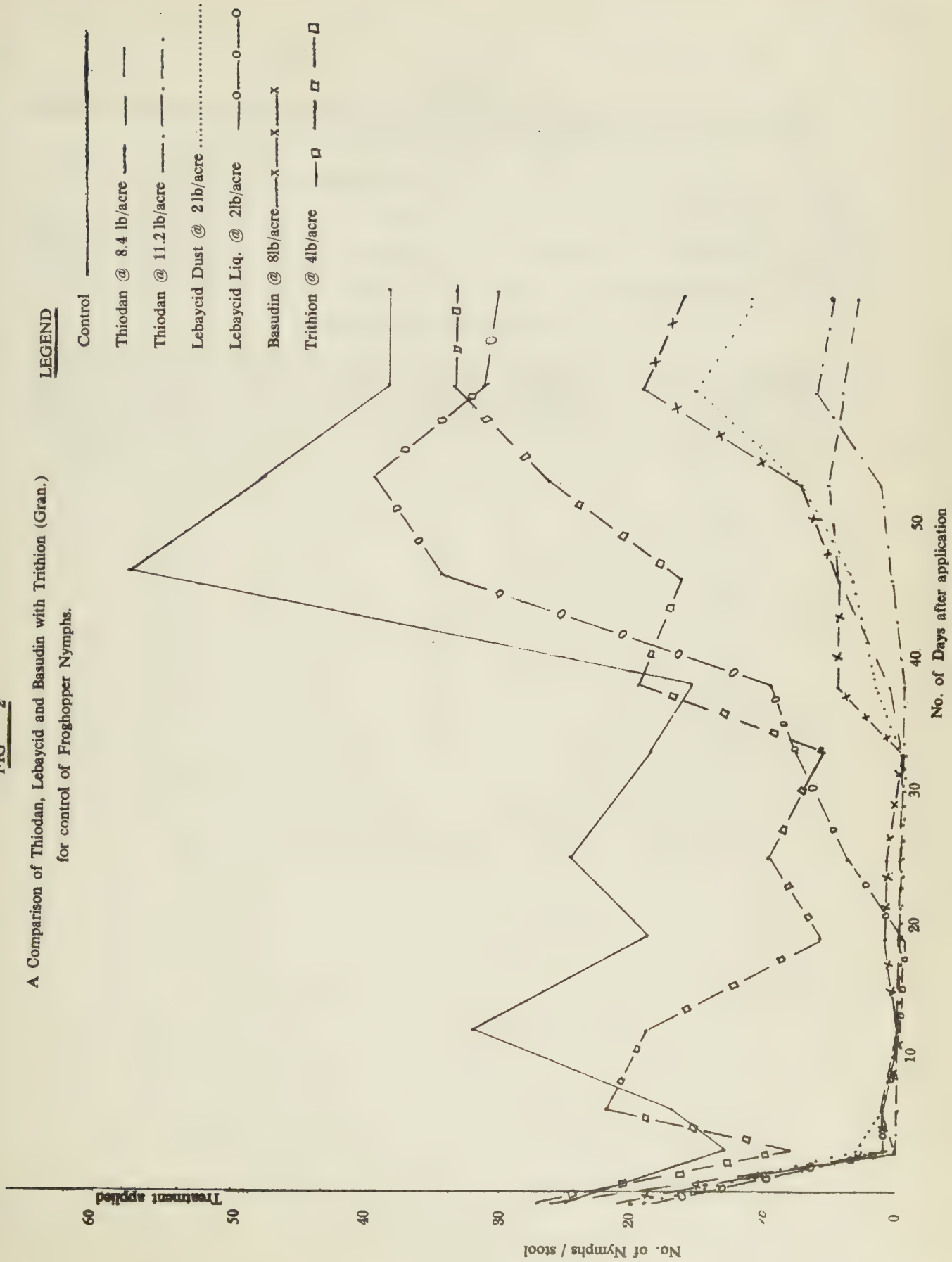


Table 7.

A Comparison of Thiodan, Lebaycid and Basudin with Trithion (Gran.) for Control of Froghopper

Nymphs

<i>Section:</i>	Curepe	<i>Date of Application:</i>	24/8/62
<i>Field:</i>	M.P. 44	<i>Rotation:</i>	2nd Ratoons
<i>Variety:</i>	B 41227	<i>Experimental Design:</i>	7 x 4 Randomised Blocks
<i>Soil Type:</i>	Cunupia Light Clay	<i>Plot Size:</i>	1/40th Acre

Results (Nymphs per Stool)

No. of days after application	Control	Thiodan 35% W.P. 8 4 lbs. act./acre	Thiodan 35% W.P. 11.2 lbs. act./acre	Lebaycid 3% Dust 2 lbs. act./acre	Basudin 10% Gran. 8 lbs. act./acre	* Lebaycid 50% Liq. 2 lbs. act./acre	Trithion 10% Gran. 4 lbs. act./acre
Pre-treatment 23/8/62	25	26	21	20	21	19	27
3	13	0	1	3	1	1	8
6	17	1	0	1	1	1	22
12	32	0	0	0	0	0	19
19	19	0	0	0	1	0	6
25	25	0	0	0	1	4	10
33	19	0	0	0	0	8	6
38	16	1	0	2	5	10	20
46	58	5	1	4	5	35	17
53	48	6	2	8	8	40	27
60	39	5	7	16	20	32	34
67	39	4	6	12	17	31	34

* Lebaycid 50% liquid was applied in 60 gallons of water per acre.

Table 8.

A Comparison of DDT, Antiresistant DDT, and Dieldrin with Thimet for Control of Froghopper Nymphs

Section: Curepe Date of Application: 7/9/62
 Field: M.P. 31 Rotation: 3rd Ratoons
 Variety: B 41227 Experimental Design: 5 x 4 Randomised Blocks
 Soil Type: Cunupia Light Clay Plot Size: 1/40th Acre

Results (Nymphs per Stool)

No. of Days after Application	Control	DDT 10 lbs. act./acre	DDT Anti- resistant 10 lbs act./acre	Dieldrin 10 lbs. act./acre	Thimet 2 lbs. act./acre
Pre-treatment 7/9/62	3	5	4	2	3
1	2	1	1	0	1
7	0	0	1	0	0
14	1	0	0	0	0
21	1	1	0	1	0
27	9	0	0	0	6
34	5	0	0	0	3
41	7	0	0	0	9
48	3	0	0	0	2

Table 9

*A Comparison of Esso Agricultural Mulch, Mulch + Trithion,
Mulch + DDT with (Gran.) Trithion and DDT*

Section: Curepe Date of Application: 6/9/62
 Field: M.P. 31 Rotation: 3rd Ratoons
 Variety: B 41227 Experimental Design: 6 x 3 Randomised Blocks
 Soil Type: Cunupia Light Clay Plot Size: 1/400th Acre

Results (Nymphs per Stool)

No. of Days after Application	Control	Mulch 400 gall. per acre.	Mulch + Trithion 4 lbs. act./acre	Trithion 4 lbs. act./acre	DDT 6.7 lbs. act./acre	Mulch + DDT 6.7 lbs. + 400 gal. act./acre
Pre-treatment 5/9/62	11	15	10	16	22	11
2	7	7	5	6	5	6
8	6	6	3	3	3	6
15	8	15	12	5	6	9
22	18	19	7	9	4	10
28	25	31	8	4	2	18
35	27	30	15	15	11	14
42	68	56	88	66	78	68

Mulch, Mulch + Trithion, Mulch + DDT were applied at 400 galls.
per acre. Nymphs counts were made in marked stools.

FIG 3

A Comparison of Folidol and Shell SD 3562 with Thiodan for control of Froghopper Nymphs

LEGEND

- Control —————
- Thiodan @ 8.4 lb/acre ———
- Folidol @ 1 1/4 gall/acre
- Shell @ 2lb/acre ———○———

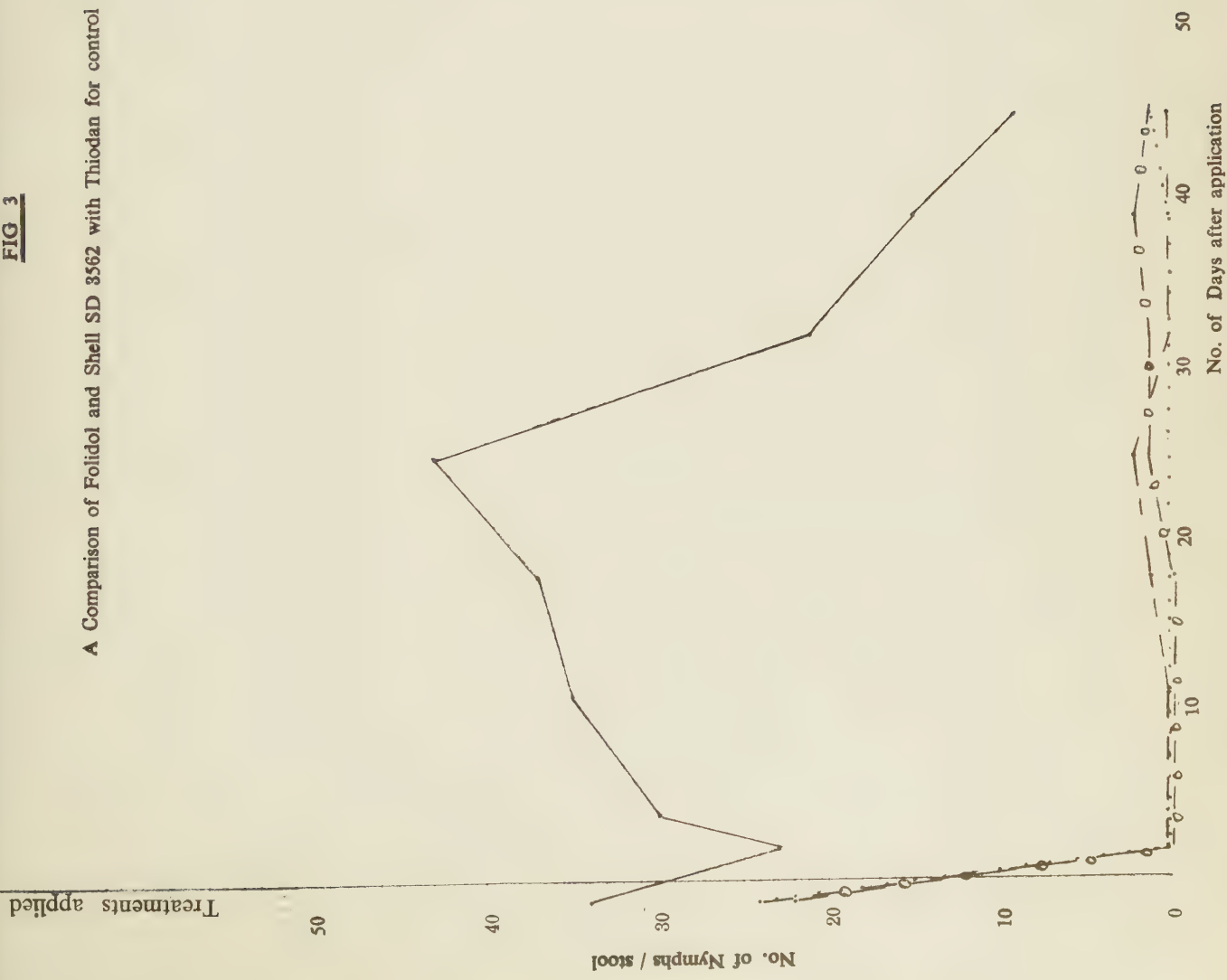


Table 10.

A Comparison of Folidol, Dipterex, and Shell SD 3562 with Thiodan for Control of Froghopper Nymphs

Section: Waterloo

Field: Union 6

Variety: B 41227

Soil Type: Waterloo Loam and Clay

Date of Application: 20/9/62

Rotation: 1st Ratoons

Experimental Design: 9 x 4 Randomised Blocks

Plot Size: 1/40th Acre

Results (Nymphs per Stool)

	No. of Days after Application	Control	* Thiodan 8.4 lbs. act./acre	* Thiodan 11.2 lbs. act./acre	* Folidol 1¼ Gall. act./acre	* Folidol 2½ Gall. act./acre	* Dipterex 2.4 lbs. act./acre	* Dipterex 4.8 lbs. act./acre	* Shell 2 lbs. act./acre	* Shell 4 lbs. act./acre
Pre-treatment	20/9/62	34	22	38	24	27	25	19	24	23
	2	23	0	0	0	0	4	4	0	0
	4	30	0	1	0	0	1	0	0	0
	11	35	0	0	0	0	20	11	0	0
	18	37	1	0	0	0	8	13	0	0
	25	43	2	1	0	0	29	27	1	1
	32	21	0	0	0	0	19	17	1	0
	39	15	0	0	0	0	14	15	2	1
	45	9	0	0	1	0	4	9	1	2

* All treatments were applied in 60 gallons of water per acre.

A Comparison of Lebaycid and Metasystox for Control of Froghopper Nymphs

<i>Section :</i>	McBean	<i>Date of Application :</i>	1/10/62
<i>Field :</i>	Est. 17	<i>Rotation:</i>	2nd Ratoons
<i>Variety:</i>	B 41227	<i>Experimental Design :</i>	5 x 5 Latin Square
<i>Soil.Type :</i>	Mc Bean Sand & Loam	<i>Plot Size:</i>	1/40th Acre

Results (Nymphs per Stool)

	No. of Days after Application	Control	Lebaycid 2 lbs. act./acre	Lebaycid 4 lbs. act./acre	*Metasys- tox R ½ Gall. per acre	*Metasys- tox R 1 Gall. per acre
Pre-treatment	29/9/62	19	18	25	20	22
	3	10	2	2	6	1
	8	13	1	0	5	3
	19	31	3	1	14	8
	22	17	4	4	9	5
	29	11	1	8	16	14
	35	10	3	2	15	7

* Treatments applied in 60 gallons of water per acre.

Table 12.

*A Comparison of Perthane, Rhothane, and UC 16888 with Trithion Dust for Control of Froghopper Nymphs**Section:* Mc Bean*Date of Application:* 16/10/62*Field:* C.N. 33 (West End)*Rotation:* 2nd Ratoons*Variety:* B 41227*Experimental Design:* 11 x 4 Randomised Blocks*Soil Type:* McBean Sand & Loam*Plot Size:* 1/80th Acre*Results (Nymphs per Stool)*

	No. of Days after Application	Control 1	Control 2	* Perthane 1 lb. act./acre	* Perthane 2 lbs. act./acre	* Perthane 4 lbs. act./acre	Rhothane 3 lbs. act./acre	Rhothane 6 lbs. act./acre	Rhothane 9 lbs. act./acre	* UC 16888 1½ lbs. act./acre	* UC 16888 3 lbs. act./acre	Trithion 6.7 lbs. act./acre
Pre-treatment	15/10/62	30	31	32	29	31	31	29	31	37	33	32
	3	23	20	27	19	23	12	20	16	7	4	12
	7	26	26	26	24	23	18	23	23	6	5	6
	14	22	12	14	11	17	6	11	11	6	1	2

* Treatments applied in 60 gallons of water per acre.

Table 13.

*A Comparison of Disyston with Thimet and
Trithion for Control of Froghopper Nymphs*

Section :	Mc Bean	Date of Application :	11/10/62
Field :	C.N. 33 (East End)	Rotation:	2nd Ratoons
Variety:	B 41227	Experimental Design :	6 x 4 Randomised Blocks
Soil Type :	Mc Bean Sand & Loam	Plot Size:	1/40th Acre

Results (Nymphs per Stool)

No. of Days after Application	Control	Disyston 2 lbs. act./acre	Disyston 3 lbs. act./acre	Disyston 4 lbs. act./acre	Thimet (Gran.) 2 lbs. act./acre	Trithion 5.6 lbs act./acre
Pre-treatment 10/10/62	43	46	49	48	51	46
2	26	13	21	15	10	17
8	15	2	0	1	2	1
12	24	1	1	0	0	1

Summary

Three insecticides, Thiodan, Folidol and EPN have provided excellent control of froghopper nymphs in the trials in which they were included. It would be of particular interest to evaluate these on a limited field scale during 1963.

Folidol has shown activity when applied directly over trash and weeds and it is possible that with motorized low-volume power sprayers

the liquid formulation could be applied on a field scale with some success. Thiodan and EPN also deserve further testing on a broader scale.

Lebaycid, Imidan, Shell SD 3562 and UCC 16888 have shown enough promise to warrant further experimental evaluation next year. Rhothane, perthane, metasystox R, dipterex, and the agricultural mulch proved relatively ineffective against froghopper nymphs.

B. Insecticides (for Control of *Aeneolamia varia saccharina* Distant) (Continued)

2. at Ste. Madeleine

F. B. Little
E. M. Johnson

The following insecticides were evaluated for control of froghopper nymphs at Ste. Madeleine during 1962 :

1. Thimet	—	0,0-Diethyl <i>S</i> -(ethylthiomethyl) phosphorodithioate.
2. Trithion	—	0,0-Diethyl <i>S-p</i> -chlorophenylthiomethyl phosphorodithioate.
3. Sevin	—	1-Naphthyl <i>N</i> -methylcarbamate
4. Dieldrin	—	1, 2, 3, 4, 10-hexachloro- <i>exo</i> -6, 7-epoxy-1, 4, 4a, 5, 6, 7, 8a-octahydro-1, 4- <i>endo</i> , <i>exo</i> -4, 8 dimethanonaphthalene.
5. Aldrin	—	Endo- <i>exo</i> isomer of 1, 2; 3, 4, 10, 10-hexachloro-1, 4, 4a, 5, 8a-hexahydro-1, 4, 5, 8-dimethanonaphthalene.
6. Telodrin	—	1, 3, 4, 5, 6, 7, 8, 8-octachloro-3a, 4, 7, 7a-tetrahydro-4, 7-methanophthalan.
7. Dipterex	—	Dimethyl trichlorohydroxyethyl phosphate
8. Lebaycid		Dimethyl-methylmercaptomethyl-phenylthiophosphate.
9. Folidol	—	Dimethyl- <i>p</i> -nitrophenyl-thiophosphate
10. Metasystox	—	Dimethyl ethyl sulphonyethyl thiophosphate

Thimet and Trithion were included as standards in the majority of experiments. Methods of application were approximately the same as those described under Insecticides, Caroni Limited. Nymph counts were made prior to application of chemical and at weekly intervals after application. The nymphs occurring about the base of five cane stools per plot were recorded at each observation date. Counts were discontinued at about nine weeks after application of insecticide or earlier if nymph control was poor. Several of the trials are still in progress.

One important aim of the insecticide trials at Ste. Madeleine was to determine whether trash and weeds, present in the fields before dusting, need to be removed to obtain satisfactory control of nymphs with a given insecticide. Weeding and cleaning fields before applying insecticides is expensive (i.e. \$20 to \$30 per acre), labour often complains about having to do the job, and in general, it is a task which might well be eliminated, if a suitable insecticide can be found. In the experiments reported in Tables 1 to 9, insecticides were applied over trash and weeds or to areas cleaned of trash and weeds in a split-plot design.

Results

The results are discussed under the following headings :

1. Trials with granular insecticides : Dieldrin, Aldrin, Telodrin, Sevin, Dipterex, Lebaycid, Thimet, and Trithion.
2. Trials with three new insecticides from Bayer Leverkusen (Folidol, Dipterex, and Lebaycid).
3. Trials with the systemic insecticide, Metasystox R, and
4. Trials with an "agricultural mulch" containing insecticides (Sevin or Dieldrin), or with mulch lacking an insecticide.

a. Granular Insecticides

Granular formulation of Dieldrin, Aldrin, Telodrin, Sevin, Dipterex, Lebaycid, Trithion, and

Thimet were evaluated in the experiments outlined in Tables 1, 2 and 3. All treatments were applied either with no prior preparation of the cane stools ('Trash') or after the stools had been weeded and the trash removed ('Clean'). The results of the experiments (Figure 1, Tables 1 and 2) demonstrated that Thimet (10% granular) applied at 20 lb. per acre over trash or on 'cleaned' stools performed more effectively than the other treatments. In the trial at La Gloria L.P. 3 (Table 2, Figure 1) all insecticides gave acceptable low nymph counts for 28 days following application but later the counts rose more sharply in plots treated with Dieldrin, Aldrin, Sevin, and Trithion than in the plots which had been dusted with Thimet. In this particular trial Trithion was applied at 5 lb. active per acre, one pound more than is usually used on the Estates. Dieldrin, Aldrin, and Sevin were used at 4 lb. active per acre.

In a trial at Reform HH 35 (Table 3, Figure 2) there was little difference between the performance of the test insecticides. Telodrin (40 lbs. per acre of 5% granules) and Lebaycid (150 lbs. of 2% granules) were as effective as Trithion (40 lbs. of 5% granules). Thimet (20 lbs. per acre of 10% granules) gave low nymph counts up to 63 days after application.

The results of the trial at Reform U 10 (Table 1) were disappointing. None of the treatments, with the exception of Thimet, controlled nymphs beyond 42 days after the initial application. The nymph counts in the three experiments (Tables 1, 2 and 3) were too low to reflect major differences between the test insecticides. Of particular interest, however, is the fact that Thimet performed consistently well whether it was applied to clean stools or directly over trash and weeds. The trials also demonstrated, in confirmation of similar results at Caroni Limited, that Trithion granular does not possess the insecticidal potency shown by Thimet granular.

b. Evaluation of Folidol, Dipterex, and Lebaycid (Bayer Leverkusen)

(a) Folidol M40 is a liquid. It was applied at 1¼ and 2½ gallons per acre in 60 gallons of water by knapsack sprayer. At 1¼ gallons per acre (Table 5), Folidol was as effective as 40 lbs. per acre of Trithion 10% granular. In a second trial (Table 4, Figure 3) the new insecticide at 2½ gallons per acre also equalled the performance of 10% Trithion granular. A point of interest is the fact that Folidol controlled nymphs irrespective of whether the chemical was applied over trash or onto 'cleaned' stools. The experiments are still in progress.

(b) Dipterex SP80 is a wettable powder. It was used at 3 and 6 lbs. product per acre and

was applied in 60 gallons of water by knapsack sprayer.

In Tables 4 and 5, and Figures 3 and 4, it may be noted that the insecticide gave a rapid kill of nymphs and was controlling froghopper up to 30 days after application. The trial is being continued.

(c) Lebaycid contains the same active ingredient as Baytex, which had shown promise in last year's trials (see Special Report on Insecticides, C.A.R.S., pages 23, 27, and 30). Lebaycid was evaluated as five different formulations:

1. 2% granular (Table 3)
2. 50% liquid (Tables 4, 5, and 6)
3. 3% dust (Table 6)
4. 25% wettable powder (Table 6), and
5. 40% wettable powder (Table 6).

The compound was used at 1 lb. active per acre (Table 5, Figure 4), 2 lbs. active (Table 4, Figure 3), and 3 lbs. active per acre (Tables 3 and 6, Figures 2 and 5).

At 2 lbs. active per acre (Table 4, Figure 3) the 50% liquid formulation provided a rapid initial kill of nymphs, and up to 37 days after treatment control has been satisfactory. It has performed well applied over trash. The trial is being continued to obtain more information on residual activity.

At 1 lb. active per acre (Table 5, Figure 4), the 50% liquid formulation of Lebaycid was not as effective applied directly over trash as compared to applications to cleaned stools. The wettable powder formulation (Table 6, Figure 5) performed as well applied over trash as applied to clean stools but the active ingredient in this case amounted to 3 lbs. per acre. The trials at Caroni Limited indicated that Lebaycid at 2 and 4 lbs. active per acre did not control nymphs beyond 35 days after application. Therefore it will be of interest to follow the results of the trials at Ste. Madeleine when the present series of experiments have been completed.

c. Evaluation of the Systemic Insecticide — Metasystox R

Metasystox R was compared with Thimet for control of froghopper nymphs in two trials. The compound is a liquid and was applied in water at 15 gallons per acre by knapsack sprayer.

Although froghopper adult counts were carried out in treated areas, the adult infestations were too low to be of much value. At 16, 24, and 40 fl. ozs. per acre, Metasystox R reduced nymph counts rapidly after application even though the insecticide was applied over a heavy

trash and weed cover (Tables 7 and 8, Figure 6). Thimet granular, which was included as the standard, performed exceptionally well in the two trials (Tables 7 and 8, Figure 6). Initial kill of nymphs was rapid, and residual activity was good.

The relatively low cost of Metasystox R would permit the chemical to be used at three times the strength reported here and it would still be cost-competitive with Trithion, Thimet, or Sevin. Further trials with Metasystox R are planned during 1963. It is hoped that the 1963 experiments may be designed to measure its systemic activity more efficiently.

d. Evaluation of an Agricultural Mulch With and Without Insecticides

The "agricultural mulch" as supplied by Esso is a viscous, black, tar-like liquid. It is insoluble in water but soluble in mineral oil. The mulch has been used elsewhere to preserve moisture and to control weeds in newly-seeded fields. It was thought desirable to evaluate the effectiveness of the mulch in affecting the mobility of frog hopper nymphs and thereby reduce the numbers of frog hopper adults capable of emerging from spittle.

Formulations of mulch containing Sevin and Dieldrin were prepared by the manufacturer. These were compared with an ordinary mulch sample lacking insecticide. The compounds were

applied by sprayer fitted with a No. 6508 Teejet nozzle. At time of writing results are available up to 3 weeks after application.

The mulch containing Sevin or Dieldrin (Table 9) gave a quick initial kill of nymphs, while the mulch lacking insecticides was ineffective. There were no significant differences between the insecticides applied as dusts in ground limestone or the insecticides applied in mulch. However during extremely wet weather, insecticides in a hydrophobic mulch might well persist in soil for much longer periods than the conventional dust formulations. Unfortunately during the course of the experiment there was not sufficient rainfall to evaluate the persistence of the mulch.

Performance of Insecticides on the Estates

As of the 15th October, 1962, 4,953 acres were dusted with insecticides for frog hopper nymph control at Ste. Madeleine, and, on the whole, as of November, 1962, blight has been successfully controlled. Several different insecticides have been "rotated" against frog hopper for the past few years in an attempt to delay the selection of resistant strains. Thus far, the programme has been successful, but several more years are required before we shall be in a position to assess the merits of the system. During 1962 the compounds in use against frog hopper at Ste. Madeleine up to 15th October, were as follows :

Insecticide	Chemical group	Acreage dusted	Percent of total
Thimet	Organophosphate	2107	42%
Sevin	Carbamate	1327	27%
Dieldrin	Chlorinated Hydrocarbon	949	
Agrocide	" "	319	31%
Telodrin	" "	251	
Total		4953	100

The acreage treated with each compound has been fairly evenly distributed. Thimet has been popular with the Estates mainly because the need for trashing and weeding can be eliminated prior to application, and this has reduced costs by an average of \$20 per acre. Nevertheless it may be

necessary during 1963 to reduce the acreage to be treated with Thimet and to incorporate into the rotation scheme one of the newer compounds (i.e. Folidol M40) which also has shown activity when applied over trash, and which promises to be cost-competitive with the standards.

Table 1.

*Granular Insecticides
Evaluation of Thimet and Trithion*

<i>Location:</i> Reform U 10	<i>Variety:</i>	B 46102
<i>Design:</i> 6 x 4 Randomised Blocks	<i>Rotation:</i>	2nd Ratoons
<i>Plot Size:</i> 1/40th Acre	<i>Last Reaped:</i>	16/2/62
<i>Soil Type:</i> Sevilla Clay	<i>Insecticide Applied:</i>	22/6/62

One half of each plot was weeded and the trash removed from the base of the cane stools.

Treatment per acre		Pre-Treatment	Average Number of Nymphs per Stool Days Post Treatment					
			3	10	17	25	32	39
Control (nil)	Trash	6	3	6	6	11	14	14
	Clean	7	2	10	8	9	11	16
Thimet 10% granules 20 lbs./acre	Trash	4	2	1*	5	4	9	9
	Clean	6	2	1*	5	4	11	10
Trithion 10% granules 20 lbs./acre	Trash	7	2	4	7	10	11	13
	Clean	7	2	3*	6	9	11	12
Trithion 10% granules 30 lbs./acre	Trash	6	2	3	6	11	12	13
	Clean	6	1	3*	6	7	11	16
Trithion 10% granules 40 lbs./acre	Trash	5	1	3	6	6	15	15
	Clean	3	2	3*	6	5	13	12
Trithion 10% granules 50 lbs./acre	Trash	5	1	2*	6	8	13	15
	Clean	5	1	2*	7	9	14	14
L.S.D. when P =	0.05	6	3	4	7	9	16	13

* Differences between treatments and control were statistically significant.

Table 2

Granular Insecticides
Evaluation of Thimet, Trithion, Sevin, Dieldrin, and Aldrin

Location: La Gloria L.P. 3 *Variety:* B 49119
Design: 7 x 3 Randomised Blocks *Rotation:* 2nd Ratoons
Plot Size: ½ Acre *Last Reaped:* 12/3/62
Soil Type: Talparo Clay *Insecticide Applied:* 25/6/62

One half of each plot was weeded and the trash removed from the base of the cane stools.

Treatment per acre		Pre-Treatment		Average Number of Nymphs per Stool Days Post Treatment								
				7	14	21	28	35	42	49	56	63
Control nil.	Trash+	12	29	30	14	14	19	17	20	21	12	
	Clean	9	24	24	13	9	14	16	21	19	11	
Thimet 10% granules 20 lbs./acre	Trash+	14	14	5*	4*	1*	2*	2*	7	9	5	
	Clean	12	4*	6*	2*	0*	2*	3	7	10	6	
Thimet 10% granules 40 lbs./acre	Trash+	7	3*	1*	1*	1*	2*	4	9	9	6	
	Clean	9	2*	1*	0*	0*	2*	2*	6	8	4	
Trithion 10% granules 50 lbs./acre	Trash+	9	8*	8*	4*	4*	14	12	16	17	11	
	Clean+	10	12	5*	4*	1*	15	6	9	10	8	
Sevin 10% granules 40 lbs./acre	Trash	9	8*	9*	5	3*	10*	16	15	17	10	
	Clean+	10	5*	6*	4	1*	9*	17	21	17	10	
Dieldrin 5% granules 40 lbs./acre	Trash	9	7*	8*	4*	2*	13	15	17	18	11	
	Clean+	9	9	6*	4	1*	10	10	11	10	8	
Aldrin 5% granules 40 lbs./acre	Trash	9	4*	6*	4*	3*	8*	7	10	11	8	
	Clean+	6	2*	3*	2*	2*	10	8	10	11	8	
L.S.D. when P = 0.05		11	18	18	10	4	7	15	20	18	9	

* Differences between treatments and controls were statistically significant.
+ Treatments included in Figure 1

Table 3.
Granular Insecticides
Evaluation of Thimet, Trithion, Sevin, Dieldrin, Aldrin, Telodrin, Dipterex,
and Lebaycid

Location : Reform HH 35 Variety : B 4747
Design : 9 x 4 Randomised Blocks Rotation : 2nd Ratoons
Plot Size : 1/20th Acre Last Reaped : 26/2/62
Soil Type : Sevilla Clay Insecticide Applied : 27/7/62

One half of each plot was weeded and the trash removed from the base of the cane stools.

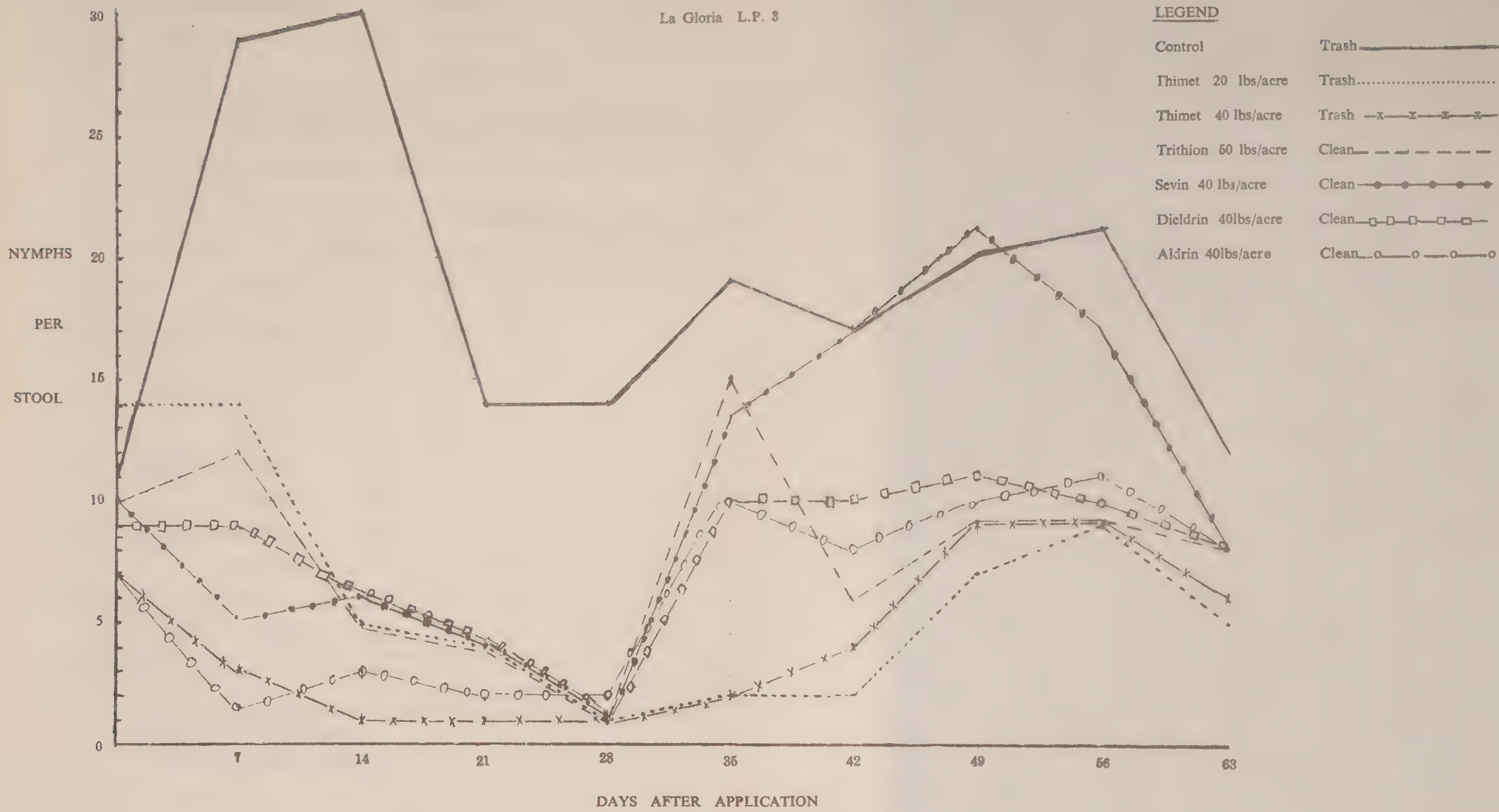
Treatment per acre		Pre-Treatment		Average Number of Nymphs per stool Days Post Treatment								
				7	14	21	28	35	42	49	56	63
Control nil.	Trash +	9	10	10	6	6	10	9	7	8	3	
	Clean	14	12	10	6	6	8	9	7	8	5	
Thimet 10% granules 20 lbs./acre	Trash +	10	3	6	2	1*	1*	1*	1*	1*	1*	
	Clean	11	2*	2	1*	2*	2*	2*	2*	2*	1*	
Trithion 10% granules 40 lbs./acre	Trash	9	3	6	3	3	4*	4	4	3*	2	
	Clean +	11	6	8	3	2*	3	2*	1*	2*	1*	
Sevin 18% granules 30 lbs/acre	Trash	9	6	7	4	2*	5	6	5	5	2	
	Clean +	10	3*	6	2	3	5	2*	4	4	2*	
Dieldrin 5% granules 20 lbs./acre	Trash	10	9	9	3	3	6	6	5	5	2	
	Clean	13	9	8	3	2*	3	4	4	4	1*	
Aldrin 5% granules 20 lbs./acre	Trash	9	5	8	4	2*	6	4	4	4	2	
	Clean	9	5	7	3	3	3	4	2*	3*	2*	
Telodrin 5% granules 40 lbs./acre	Trash	8	6	8	2	1*	2*	2*	2*	3*	1	
	Clean +	12	5	6	2	2*	2*	2*	2*	2*	1*	
Dipterex 2.5% granules 160 lbs./acre	Trash	11	5	7	3	2*	5	6	6	6	3	
	Clean	13	4	6	3	2*	4	5	6	5	2*	
Lebaycid 2% granules 150 lbs./acre (3 lbs. active)	Trash	9	2	7	2	2*	2*	1*	4	4	2	
	Clean +	15	4	4	1*	2*	4	3*	3	3*	2*	
L.S.D. when P = 0.05		9	9	11	5	4	6	6	5	5	3	

* Differences between treatments and controls were statistically significant.

+ Treatments included in Figure 2.

Figure 1
GRANULAR INSECTICIDES

La Gloria L.P. 3



*New Insecticides of Bayer Leverkusen***
*Evaluation of Thimet, Trithion, Folidol**, Dipterex**, and Lebaycid***

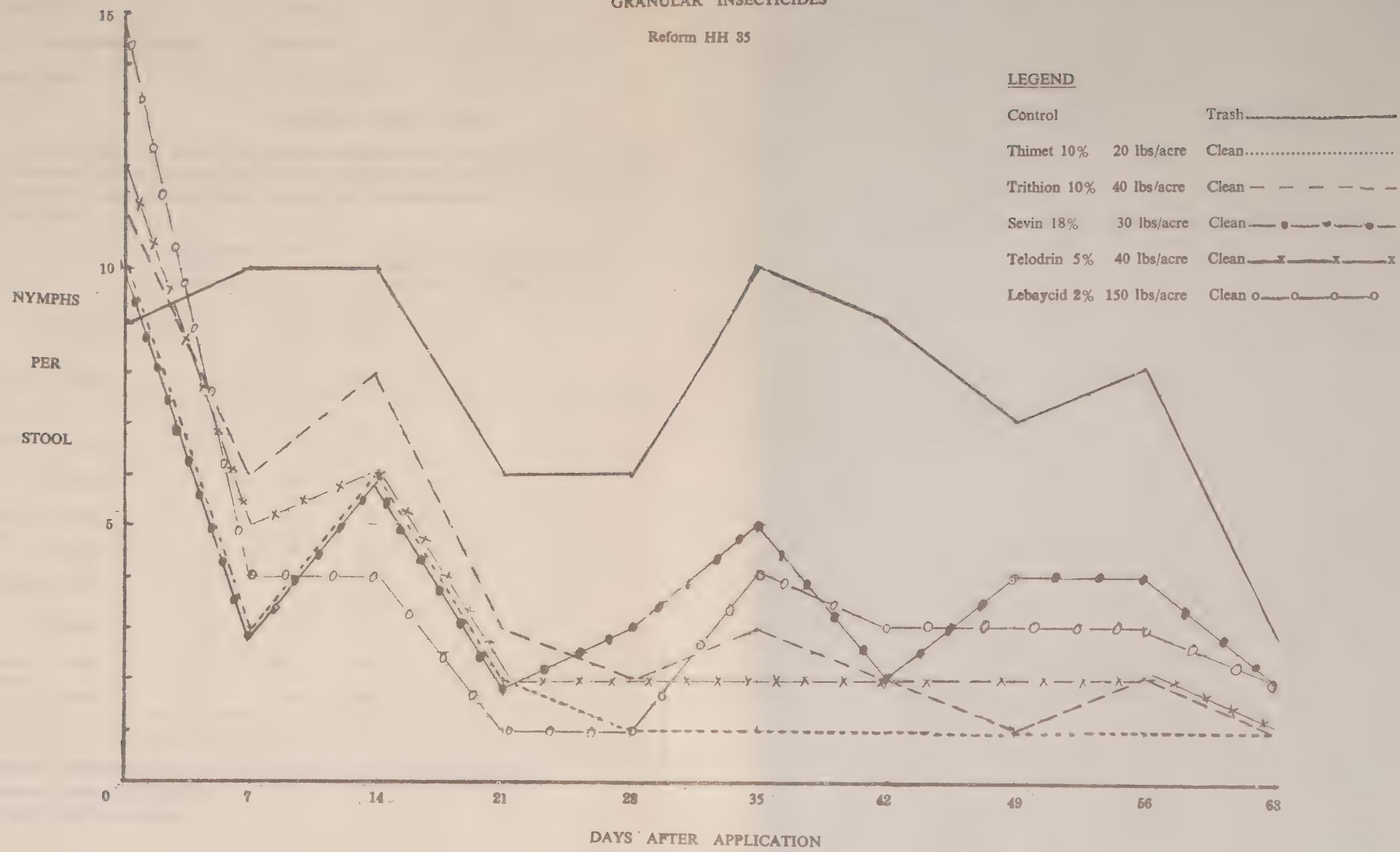
- (1) Trithion, Folidol, Dipterex, and Lebaycid were applied either without prior preparation of the stools or after the stools had been weeded and the trash removed.
- (2) Folidol, Dipterex, and Lebaycid were applied by knapsack sprayer in 60 gallons of water per acre.

* Differences between treatments and controls were statistically significant.
The trial is still in progress.
+ Treatments included in Figure 3.

Figure 2

GRANULAR INSECTICIDES

Reform HH 35



*New Insecticides of Bayer Leverkusen**
Evaluation of Thimet, Trithion, Folidol, Dipterex*, and Lebaycid**

- (1) Trithion, Folidol, Dipterex, and Lebaycid were applied either without prior preparation of the cane stools or after the stools had been weeded and the trash removed.
- (2) Folidol, Dipterex, and Lebaycid were applied by knapsack sprayer in 60 gallons of water per acre.

* Differences between treatments and controls were statistically significant.
+ Treatments included in Figure 4.
The trial is still in progress.

Figure 3

GRANULAR INSECTICIDES FROM BAYER LEVERKUSEN

Picton Pa 34

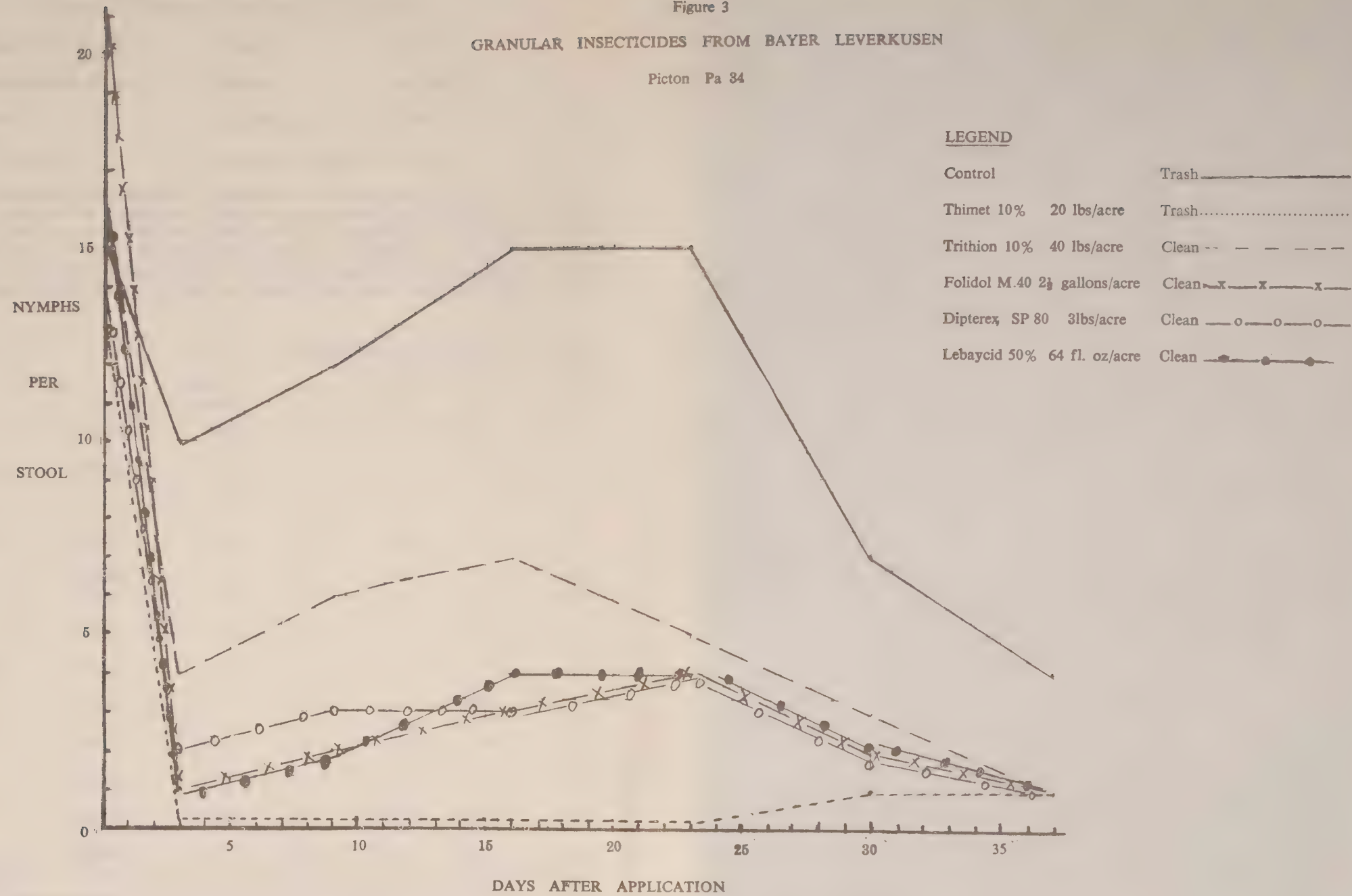


Table 6.

*New Insecticides of Bayer Leverkusen**
*Evaluation of Thimet, Trithion, and Lebaycid**

<i>Location :</i>	La Fortunee BV 20 (2)	<i>Variety :</i>	B 37172
<i>Design :</i>	12 x 4 Randomised Blocks	<i>Rotation :</i>	4th Ratoons
<i>Plot Size :</i>	1/40th Acre	<i>Last Reaped :</i>	22/4/62
<i>Soil Type :</i>	Princes Town Marl	<i>Insecticide Applied :</i>	3/10/62

The experiment compared four different formulations of Lebaycid with the two standards, Thimet and Trithion. Lebaycid was applied as a dust, a solution in 60 gallons water per acre, and as a wettable powder spray prepared from two different W.P. formulations. The wettable powder was also applied in 60 gallons of water per acre. All Lebaycid formulations were applied at the rate of 3 lbs. active per acre. The Trithion and the Lebaycid treatments were applied either without prior preparatoin of the stools or after the stools had been weeded and the trash removed.

Treatment per acre		Pre-Treatment	Average Number of Nymphs per Stool Days Post Treatment			
			2	7	14	21
Control nil.	Trash +	11	17	20	16	11
Thimet 10% granules	Trash +	9	1*	0*	0*	0*
<u>20 lbs./acre</u>						
Trithion 10% granules	Trash	10	2*	3*	3*	2*
40 lbs./acre	Clean +	8	2*	2*	3*	3*
Lebaycid 3% dust	Trash	10	2*	1*	2*	2*
100 lbs/acre	Clean +	10	2*	1*	1*	1*
(3 lbs. active)						
Lebaycid 50% liquid	Trash	11	1*	2*	2*	1*
96 fl. ozs/acre	Clean	8	2*	2*	3*	2*
(3 lbs. active)						
Lebaycid 25% W.P.	Trash	10	2*	1*	2*	2*
12 lbs/acre	Clean	9	2*	2*	2*	1*
(3 lbs. active)						
Lebaycid 40% W.P.	Trash	8	2*	1*	3*	2*
7½ lbs/acre	Clean	11	2*	1*	2*	1*
(3 lbs. active)						
L.S.D. when P = 0.05		7	3	3	5	3

* Differences between treatments and controls were statistically significant.

+ Treatments included in Figure 5.

The trial is still in progress.

Figure 4

NEW INSECTICIDES OF BAYER LEVERKUSEN

Picton Pa 27

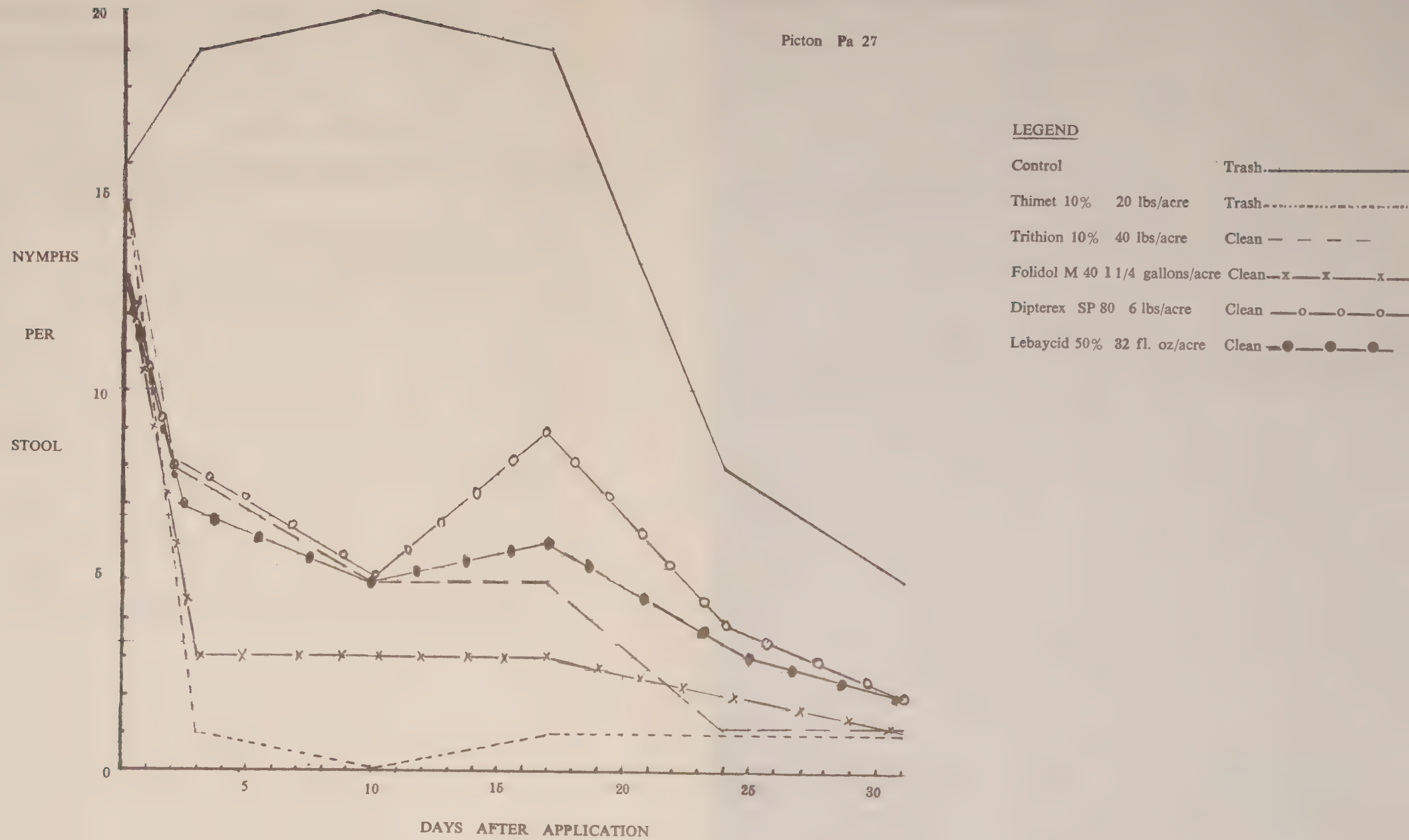


Table 7.

New Systemic Insecticides
Evaluation of Thimet and Metasystox R

<i>Location :</i>	La Fortunee BV 20 (1)	<i>Variety :</i>	B 37172
<i>Design :</i>	6 x 5 Randomised Blocks	<i>Rotation :</i>	4th Ratoons
<i>Plot Size :</i>	1/40th Acre	<i>Last Reaped :</i>	22/4/62
<i>Soil Type :</i>	Princes Town Marl	<i>Insecticide Applied :</i>	27/8/62

Metasystox R was applied at 16 and 24 fl. ozs. per acre, either by hand knapsack sprayer, high volume, 60 gallons per acre, or by power knapsack sprayer, low volume, 15 gallons per acre. Chemicals were applied over trash.

Treatment per acre	Pre-Treatment	Average Number of Nymphs per Stool Days Post Treatment								
		3	10	17	24	31	38	45	52	59
Control (nil)	17	25	10	7	9	9	10	14	10	7
Thimet 10% granules 20 lbs./acre	16	0*	0*	0*	1*	1*	2*	1*	1*	1*
Metasystox R 16 fl. ozs. 60 gall. water/acre	14	5*	2*	2*	3*	3*	6*	6*	5*	3*
15 „ „ „	13	6*	2*	2*	3*	3*	4*	5*	5*	5
Metasystox R 24 fl. ozs. 60 gall. water/acre	14	6*	2*	2*	3*	3*	4*	5*	5*	3*
15 „ „ „	14	4*	2*	2*	3*	3*	5*	5*	4*	5
L.S.D. when $P = 0.05$	7	8	3	3	3	3	4	5	4	4

* Differences between treatments and controls were statistically significant.

Figure 5

NEW INSECTICIDE OF BAYER LEVERKUSEN

La Fortune BV 20 (2)

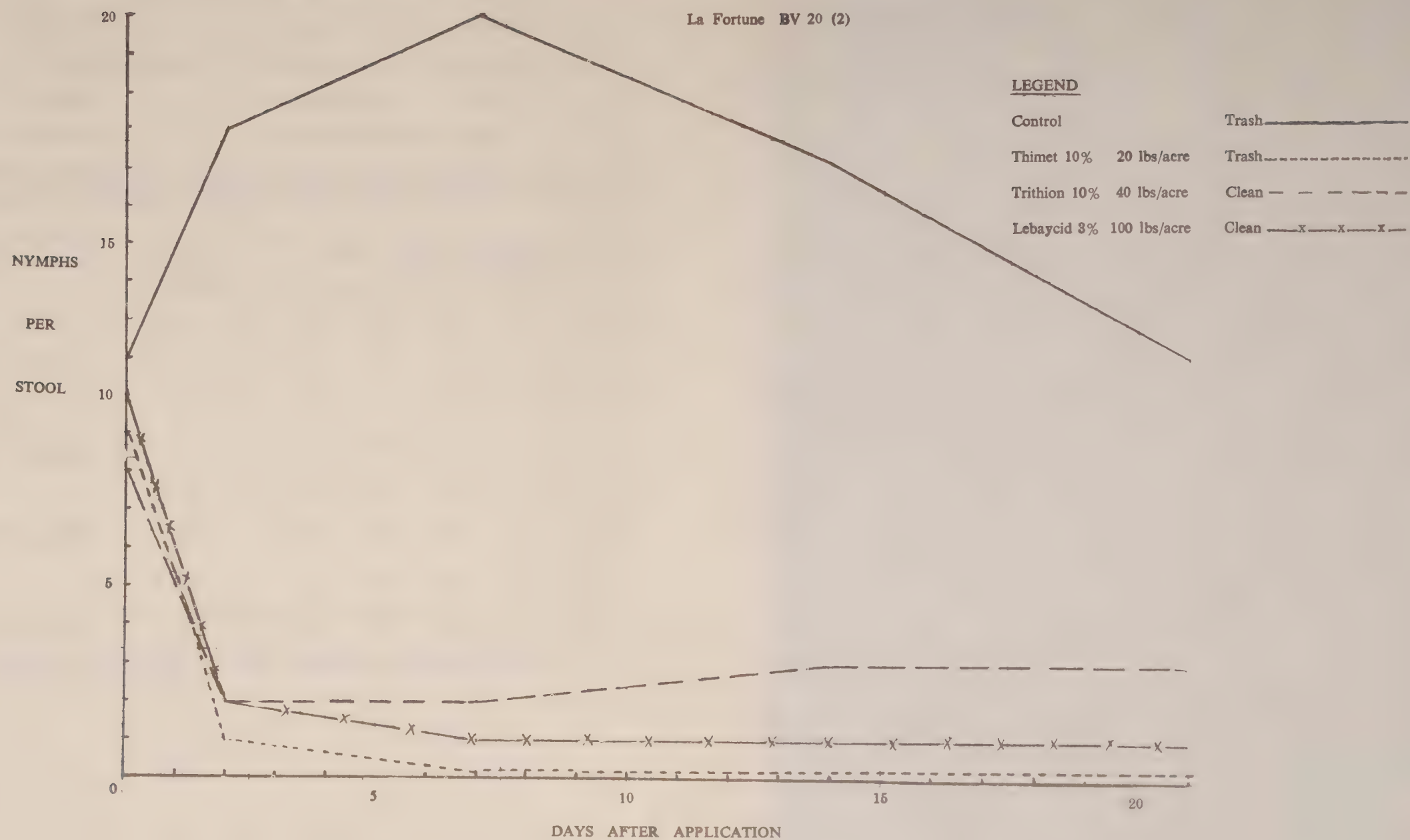


Table 8.

New Systemic Insecticides

Evaluation of Thimet and Metasystox R

Location :	Picton W 78	Variety :	B 37161
Design :	6 x 5 Randomised Blocks	Rotation :	9th Ratoons
Plot Size :	1/40th Acre	Last Reaped :	12/1/62
Soil Type :	Alluvial Black	Insecticide Applied :	6/9/62

Metasystox R was applied at 24 and 40 fl. ozs. per acre, and either by hand knapsack sprayer high volume, 60 gallons per acre, or by power knapsack sprayer, low volume, 15 gallons per acre. Chemicals were applied over trash.

Treatment per acre	Pre-Treatment	Average Number of Nymphs per Stool Days Post Treatment						
		4	11	18	25	32	39	46
Control nil.	21	19	18	7	5	3	3	2
Thimet 10% granules	20	0*	0*	1*	0*	0*	0*	0*
<u>20 lbs./acre</u>								
Metasystox R 24 fl. ozs. 60 gall. water/acre	26	3*	2*	3*	2*	2	2	1
15 " " "	25	2*	4*	5*	2*	3	3	1
Metasystox R 40 fl. ozs. 60 gall. water/acre	24	2*	3*	3*	2*	1*	1*	1
15 " " "	20	2*	3*	2*	2*	3	3	1
L.S.D. when $P = 0.05$	11	2	3	3	2	2	2	2

* Differences between treatments and controls were statistically significant.
The trial is still in progress.

Table 9.

'Agricultural Mulch'
Evaluation of Mulch without Insecticide, Mulch with Sevin,
Mulch with Dieldrin, Sevin Dust, and Dieldrin Dust

<i>Location :</i>	La Gloria LR 28	<i>Variety :</i>	B 49119
<i>Design :</i>	9 x 4 Randomised Blocks	<i>Rotation :</i>	1st Ratoons
<i>Plot Size :</i>	1/40th Acre	<i>Last Reaped :</i>	28/5/62
<i>Soil Type :</i>	Talparo Clay	<i>Insecticide Applied :</i>	29/9/62

The cane stools were cleaned before application of insecticides. Nymph counts were carried out in the usual manner, but after application the coating of mulch was not disturbed. Only nymphs were counted which appeared on the surface of the soil.

Treatment per acre	lbs. active per acre	Pre- Treatment	Average Number of Nymphs per Stool Days Post Treatment			
			4	9	16	23
Control nil.		17	11	11	8	4
100 galls. Agric. Mulch without insecticide		15	13	13	10	4
200 galls. Agric. Mulch without insecticide		14	11	7*	4*	2*
100 galls. Agric. Mulch incorporating Sevin 8 lbs. per 600 U.S. gall.	1.33	15	1*	1*	0*	1*
200 galls. Agric. Mulch incorporating Sevin 8 lbs. per 600 U.S. gall.	2.67	15	0*	0*	0*	0*
100 galls. Agric. Mulch incorporating Dieldrin 10 lb. per 600 U.S. gall.	1.67	14	2*	0*	0*	0*
200 galls. Agric. Mulch incorporating Dieldrin 10 lb. per 600 U.S. gall.	3.33	16	1*	0*	0*	1*
2 cwt. Dieldrin mixed dust	1.00	14	0*	0*	0*	0*
2 cwt. Sevin mixed dust	6.50	15	0*	1*	1*	1*
L.S.D. when $P = 0.05$		17	6	4	3	2

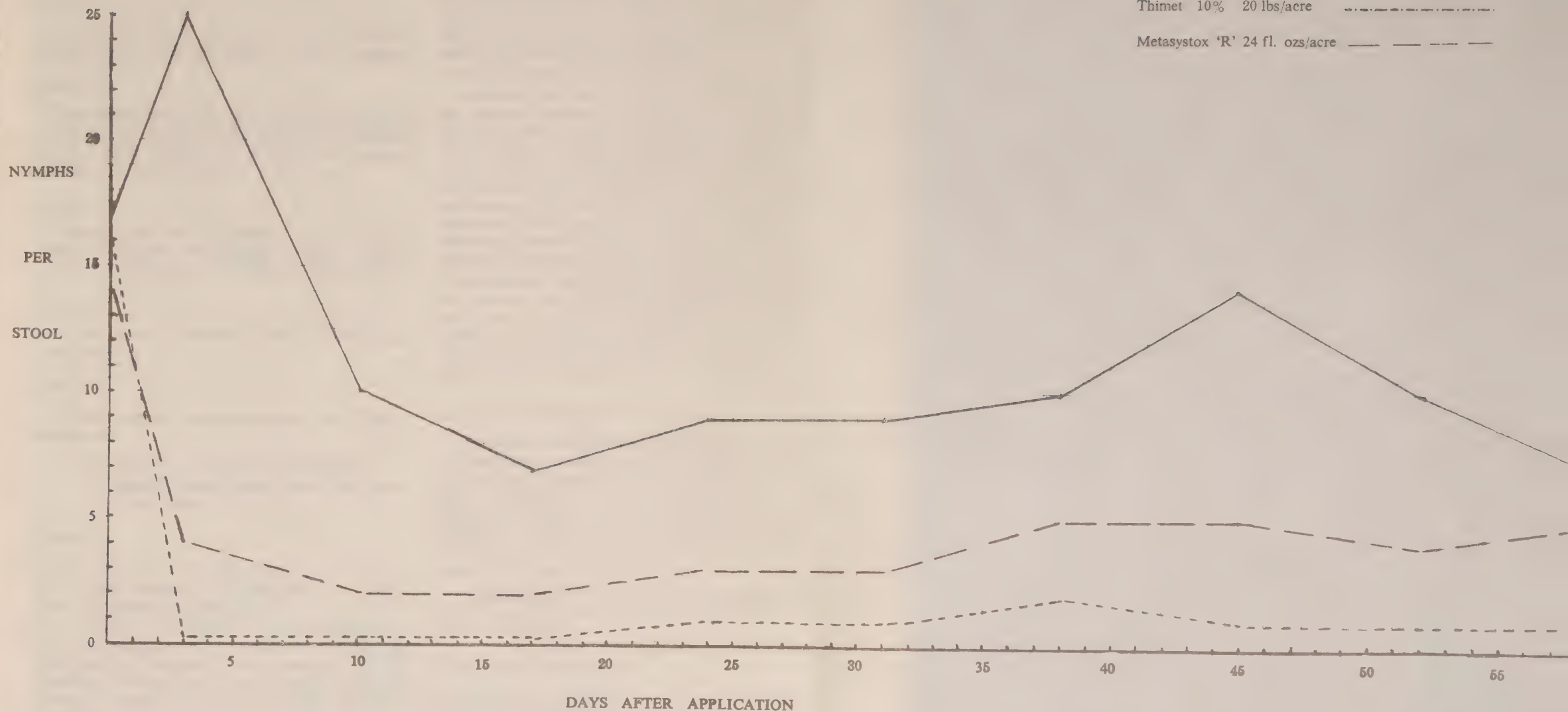
* Differences between treatments and controls were statistically significant.
 The trial is still in progress.

Figure 6
NEW SYSTEMIC INSECTICIDE

La Fortune BV 20 (1)

LEGEND

Control —————
Thimet 10% 20 lbs/acre - - - - -
Metasystox 'R' 24 fl. ozs/acre — — — — —



C. Mineral Nutrition

1. At Caroni Limited

I. D. Lawrie

Several different types of fertilizer experiments were reaped and analyzed at Caroni Limited during the year. These were as follows:

Series a.

Ten individual N, P, K, 3 x 3 x 3 factorial trials on the major soil types at Caroni Limited.

Series b.

Replicated large plot trials on seven different types of soil comparing the optimum treatments in the 1960 factorial trials with the present standard Estate practice.

Series c.

Comparison of 'complete,' ready-mixed (NPK) fertilizers with normal Estate practice (individual fertilizers) in plants and ratoons.

Series d.

Comparison of various types of nitrogenous fertilizers.

Series e.

Comparison of superphosphate and hyperphosphate:

- (1) applied in the plant year only
- (2) applied in the plant year and subsequent years

Series f.

Determination of the effect on yields of foliar applications of different levels of ammonium phosphate to plant cane.

In addition to the above, seven trials were instituted during 1962 to evaluate various formulations of 'complete,' ready-mixed (NPK) fertilizers vs standard Estate practice, which at present consists of applications of individual fertilizers.

Summary of Results:

Series a.

Six of the ten factorial trials gave statistically significant responses to one and/or another of the major elements (see Appendices 33 to 42).

Response to Nitrogen:

Significant increases in tons sugar per acre were induced by nitrogen applications (sulphate of ammonia) on the following soil types; Frederick very heavy clay, Waterloo loam and clay, Bejucal very heavy clay, and Freeport clay, while the differences on Talparo clay were questionable. (Appendices 33, 37, 38, 42, and 36).

Generally an increase in the quantity of nitrogen applied resulted in an increase in tons cane per acre, with a corresponding deterioration in juice quality, as expressed by the ratio tons cane per ton sugar. In two experiments significant increases in yield of sugar were obtained with applications of 6 cwt. per acre of sulphate of ammonia, which amounts to 2 cwt. sulphate of ammonia per acre over that of present Estate practice (Appendices 33 and 37).

Interactions were recorded between potassium and nitrogen on Frederick very heavy clay, Talparo clay, Sevilla clay, and Freeport clay (Appendices 33, 36, 39, and 42). There were no statistically significant interactions between phosphorous and nitrogen.

Response to Phosphorus:

There were statistically significant responses to phosphorus on Frederick very heavy clay and Talparo clay (Appendices 33 and 36). Interactions between potassium and phosphorus were obtained on Sevilla clay and Talparo clay (Appendices 35 and 36). In ratoons, responses were obtained to 'residual' phosphorus; the element having been applied at planting.

Superphosphate (40% P₂O₅) applications at 2 cwt. per acre were as effective as 4 cwt. per acre in all trials.

Response to Potassium:

Responses to potassium were noted on Talparo clay and Waterloo loam and clay (Appendices 36 and 37).

Interestingly, no responses to potassium were obtained on Couva loam and clay, Sevilla clay, McBean sand and loam, and Cunupia medium clay (Appendices 34, 35, 40, and 41), though statistically significant differences had been obtained last year between plots which had received the element and those which had not.

Two cwts. per acre of muriate of potash (60% K_2O) was as effective as 4 cwts. per acre in the 1962 experiments.

A summary of results from factorial trials over a four-year period (1959-1962) is presented in Appendix 59.

Series b.

Eight large plot fertilizer experiments were established in 1960 and were reaped as 1st ratoons in 1962. Plot size was approximately $\frac{1}{4}$ acre with replicated treatments laid out in a randomised block design. The trials were reaped according to the usual Estate practice.

No significant increase in yield over the normal Estate fertilizer practice was obtained in any of the experiments (Appendices 43—50), although significant responses were obtained last year on McBean sand and loam, Frederick very heavy clay, and Bejucal very heavy clay.

It should be mentioned that the treatments applied in the experiments described in Series B were those which gave the best results in the factorial experiments in previous years.

Series c.

These experiments were established in 1960 and were reaped as ratoons in 1962 to compare 'complete' NPK fertilizers with individual applications of the major elements. No statistically significant differences were obtained in 1st and 2nd ratoons between 4 cwt. per acre of 'complete' fertilizers and 4 cwt. per acre sulphate of ammonia plus 2 cwt. per acre muriate of potash, applied individually (Appendices 51, 52, and 53).

Series d.

Significant increases in yields of sugar per acre were obtained by the application of 4 cwt. per acre of sulphate of ammonia, in one and two applications, over applications of 4 cwt. per acre of calcium nitrate and calcium ammonium nitrate (Appendix 54). No significant differences in yield were noted between plots treated with urea at 2 cwt. and calnitro and sulphate of ammonia at 4 cwt. per acre.

However, in a second and third trial no differences were noted in the sugar yield per acre between plots treated with sulphate of ammonia, urea, and calcium ammonium nitrate (Appendix 55 and 56).

Series e.

There were no statistically significant differences in sugar yield per acre between the different treatments of superphosphate and hyperphosphate when reaped as plants (Appendix 56).

Series f.

There were no statistically significant differences in sugar yield per acre between the different treatments. Interestingly, the maximum yield was obtained from normal Estate practice in which no phosphate was applied. However, yields were increased with increasing applications of ammonium phosphate (Appendix 58).

g. An Economic Assessment of Fertilizer Usage at Caroni Limited

Pre-processing costs per ton sugar were calculated from the results of the fertilizer trials described in Appendices 43 to 58. The pre-processing costs were calculated by applying the Fairrie formula $R \left(\frac{C}{V} + H \right)$ where C equals \$240 and $H = \$7.20$. The cost of additional fertilizer over that presently used on the Estates was added to the pre-process cost to give a "total cost". With the exception of the results given in Appendix 43, the standard Estate practice 4-0-2 (N-P-K) proved to be the most economical fertilizer treatment. On Bejucal very heavy clay (Appendix 43) at Felicite, the treatment 4 — 2 — 2 proved to be more economical than present practice. At Brechin Castle on Waterloo loam and clay (Appendix 51), and at Gordon Estate on Sevilla series (Appendix 52), present Estate practice was the most economical of a number of fertilizer treatments, including complete fertilizers. The economic assessment of fertilizer use at Caroni Limited indicates that, by and large, the Estates are presently using economical treatments in relation to the physiological responses of the crop.

C. Mineral Nutrition (Continued)

2. At Ste. Madeleine

F. B. Little
E. M. Johnson

a. Fertilizer Trials

At Ste. Madeleine, sixteen fertilizer trials were reaped and analyzed during Crop 1962 (Appendices 60 to 75). These represented five types of experiments, as follows :

a) determination of fertilizer requirements on New Lands at La Gloria Estate,

b) comparisons of urea and sulphate of ammonia as sources of nitrogen,

c) comparisons of ready-mixed, complete fertilizers with individual applications of sulphate of ammonia, muriate of potash, and superphosphate.

d) evaluation of differences in yields imposed as a result of applying fertilizers at different times during development of the crop, and

e) a long-term field experiment studying the interactions between liming and applications of N and P.

a. Determination of Fertilizer Requirements on New Lands at La Gloria Estate

Responses to nitrogen on new lands at La Gloria were atypical, judging from results presented in Appendix 63. Six cwt. per acre sulphate of ammonia gave decreased yields. There were responses to potash but not to phosphate. The results are not completely applicable to other areas at New Lands. For example, in two factorial experiments laid down in 1960 (Appendices 64 and 66), there were significant responses to increased quantities of nitrogenous fertilizer in one of the trials but not in the other. There were no significant responses to potash in either of the two experiments. In 1961 an additional two factorial trials were instituted adjacent to the original experiments. The objective of the experiments was to evaluate responses to various levels of N, P, and K in ratoons, following the application of the same fertilizers to plant cane. In the factorial trials there were responses to nitrogen in three of the areas (Appendices 63, 64 and 65), but not in the fourth (Appendix 66). The significant responses to phosphate were restricted to areas in which superphosphate had been applied to plant cane the previous year. There were no responses to phosphate applied to ratoons if the crop had already received phosphate as plants. The results suggest that the Estates could well dispense with phosphate applications to ratoons, if plants

are furnished with a sufficient quantity of superphosphate. At New Lands therefore, we recommend the following fertilizer practices :

In Plant Cane

2 to 4 cwt. sulphate of ammonia
4 cwt. superphosphate (in furrow)

In Ratoons

2 to 4 cwt. sulphate of ammonia

b. Comparisons of Urea and Sulphate of Ammonia As Sources of Nitrogen

No significant differences in yield were obtained between plots which received urea or sulphate of ammonia as nitrogen sources (Appendices 68, 69, 70, and 75). In two trials, responses to nitrogen were lacking, which may indicate some limiting factor other than a major element deficiency (Appendices 68 and 69).

c. Comparisons of "Ready-Mixed" and Individual Fertilizers

A number of ready-mixed fertilizers have been evaluated at Ste. Madeleine over the past three years. During 1962 it was found that plots which had been treated with the ready-mixed formulations Di-Mon 18:46:0 (Appendix 60), Binape 16:20:0 (Appendix 60), Binario 25:20:0 (Appendix 60), Ammo-Phos-Ko 10:20:20 (Appendices 71, 72, and 74), and Ammo-Phos-Ko 13:13:13 (Appendices 71, 72, and 74) produced yields comparable to those of plots which received dressings of individual fertilizers.

The results indicate that ready-mixed fertilizers are as effective, physiologically, as present fertilizer practices. The choice of formulation will have to depend upon the price of the given fertilizer.

d. Timing of Fertilizer Applications As it Influences Yields

In two experiments (Appendices 61 and 62), fertilizers were applied at : 1) time of banking, 2) at planting, and 3) at 8 weeks after planting. On the Estates, up to 1962, sulphate of ammonia and superphosphate were generally applied to plants at 6 to 8 weeks after planting, coinciding

with the "breaking" of second banks. In 1962 superphosphate was applied prior to planting, while sulphate of ammonia was applied at 6 to 8 weeks after planting. The present experiments evaluated both practices.

As may be noted in Appendix 61, there were no significant differences in TS/A between fertilizer treatments, irrespective of when they were applied. The lowest pre-processing costs per ton sugar were obtained from plots treated with 4 cwt. sulphate of ammonia at 8 weeks after planting (Appendices 61 and 62).

e. Long-term N x P x Lime Experiment

There were no significant differences between treatments in a long-term liming experiment (Appendix 73). The trial has been in progress for over 20 years. In 1962 the plots were replanted with B 49119, and the experiment is to be continued.

f. Foliar and Root Diagnoses

A detailed discussion of foliar diagnosis as a guide in determining the mineral nutrient requirements of sugar cane grown under Trinidad conditions is presented in the Plant Physiology section. However, leaf samples (top visible dew-

lap) were also collected from the four factorial experiments at New Lands (Appendices 63, 64, 65, and 66) and were analyzed for N, P, and K at various stages in development (i.e. 3, 4 and 5 months of age). The methods of sampling and analysis were identical with those described under Plant Physiology. It is the objective of the present study to define the interactions between quantity of fertilizer applied to the soil in which the cane is growing, the level of N, P, and K in the leaf, and the final yields. Yield data are not as yet available from the present experiments, but the analyses reflect increasing percentages of N, P, K, in the top visible dewlap leaf as the quantity of fertilizer applied to the plots was increased (Tables 1 to 4). In general, the leaf analyses from New Lands indicate that the levels of N, P, and K are adequate. Yield data, to be collected during 1963 Crop, are required to confirm this. It is of interest to note that the analysis at 5 months (Table 1) indicates a reduction in potash levels of leaves on Talparo clay, which may be a reflection of the low monthly rainfall (i.e. 3") preceding the sampling. Similarly in Table 2, it may be noted that leaf potash levels at 5 months also were depressed. However on the calcareous green clay, the foliar levels of K and P remained consistently high at 4 and 5 months, but N levels were depressed, particularly at 5 months.

Table 1.
Analysis of Top Visible Dewlap Leaves of 3, 4, and 5 month-old 2nd Ratoons
La Gloria S.L.4 (1) Soil — Talparo Clay

Age (Months)	Nitrogen %			Monthly Rainfall (Inches)
	N0	N1	N2	
3	2.26	2.40	2.53	15.7
4	1.96	2.16	2.13	15.2
5	2.22	2.19	2.27	3.0

N0 = 2 cwts. sulphate of ammonia per acre

N1 = 4 cwts. sulphate of ammonia per acre

N2 = 6 cwts. sulphate of ammonia per acre

Age (Months)	Phosphate %			Monthly Rainfall (Inches)
	P0	P1	P2	
3	0.192	0.266	0.268	15.7
4	0.404	0.444	0.442	15.2
5	0.388	0.434	0.463	3.0

P0 = nil

P1 = 2 cwts. 40% superphosphate per acre

P2 = 4 cwts. 40% superphosphate per acre

Age (Months)	Potash %			Monthly Rainfall (Inches)
	K0	K1	K2	
3	1.32	1.76	1.72	15.7
3	1.74	1.75	2.11	15.2
5	1.48	1.43	1.44	3.0

K0 = nil

K1 = 2 cwts. muriate of potash per acre

K2 = 4 cwts. muriate of potash per acre

In this trial the same fertilizer treatments were applied to the second ratoons as had been applied to the plants and first ratoons in the two previous years.

Table 2.

Analysis of Top Visible Dewlap Leaves of 3, 4, and 5 month-old 2nd Ratoons
La Gloria S.L.4 (2) Soil — Talparo Clay

Nitrogen %

Age (Months)	N 0	N 1	N 2	Monthly Rainfall (Inches)
3	2.48	2.50	2.72	15.7
4	2.30	2.42	2.37	15.2
5	2.26	2.51	2.34	3.0

N0 = nil

N1 = 3 cwts. sulphate of ammonia per acre

N2 = 6 cwts. sulphate of ammonia per acre

Phosphate %

Age (Months)	P0	P1	P2	Monthly Rainfall (Inches)
3	0.221	0.260	0.282	15.7
4	0.313	0.367	0.359	15.2
5	0.384	0.402	0.434	3.0

P0 = nil

P1 = 2 cwts. 40% superphosphate per acre

P2 = 4 cwts. 40% superphosphate per acre

Potash %

Age (Months)	K0	K1	K2	Monthly Rainfall (Inches)
3	1.51	1.59	1.72	15.7
4	1.28	1.39	1.45	15.2
5	1.17	1.31	1.37	3.0

K0 = nil

K1 = 2 cwts. muriate of potash per acre

K2 = 4 cwts. muriate of potash per acre

This trial was begun as ratoons. As plant cane the area in which the trial is located had been treated with 4 cwts. sulphate of ammonia plus 3 cwts. 40% superphosphate per acre.

Table 3
Analysis of Top Visible Dewlap Leaves of 3, 4, and 5 month-old 2nd Ratoons
La Gloria S.L.16 (1) Soil — Calcareous green clay
Nitrogen %

Age (Months)	N0	N1	N2	Monthly Rainfall (Inches)
3	2.05	1.95	2.16	10.6
4	1.62	1.86	2.00	17.8
5	1.58	1.55	1.49	7.3

N0 = 2 cwts. sulphate of ammonia per acre

N1 = 4 cwts. sulphate of ammonia per acre

N2 = 6 cwts. sulphate of ammonia per acre

Phosphate %

Age (Months)	P0	P1	P2	Monthly Rainfall (Inches)
3	0.212	0.243	0.264	10.6
4	0.246	0.283	0.306	17.8
5	0.245	0.329	0.297	7.3

P0 = nil

P1 = 2 cwts. 40% superphosphate per acre

P2 = 4 cwts. 40% superphosphate per acre

Potash %

Age (Months)	K0	K1	K2	Monthly Rainfall (Inches)
3	1.34	1.49	1.61	10.6
4	1.06	1.09	1.05	17.8
5	1.41	1.60	1.69	7.3

K0 = nil

K1 = 2 cwts. muriate of potash per acre

K2 = 4 cwts. muriate of potash per acre

In this trial the same fertilizer treatments were applied to the second ratoons as had been applied to the plants and first ratoons in the two previous years.

Table 4.

Analysis of Top Visible Dewlap Leaves of 3, 4, and 5 month-old 2nd Ratoons
La Gloria S.L. 16 (2) Soil – Calcareous green clay

Nitrogen %

Age (Months)	N0	N1	N2	Monthly Rainfall (Inches)
3	1.62	1.98	2.22	10.6
4	2.04	2.16	2.26	17.8
5	1.73	1.86	1.95	7.3

N0 = nil

N1 = 3 cwts. sulphate of ammonia per acre

N2 = 6 cwts. sulphate of ammonia per acre

Phosphate %

Age (Months)	P0	P1	P2	Monthly Rainfall (Inches)
3	0.224	0.246	0.286	10.6
4	0.271	0.314	0.315	17.8
5	0.300	0.292	0.356	3.0

P0 = nil

P1 = 2 cwts. 40% superphosphate per acre

P2 = 4 cwts. 40% superphosphate per acre

Potash %

Age (Months)	K0	K1	K2	Monthly Rainfall (Inches)
3	1.34	1.61	1.70	10.6
4	1.07	1.23	1.31	17.8
5	1.48	1.50	1.61	7.3

K0 = nil

K1 = 2 cwts. muriate of potash per acre

K2 = 4 cwts. muriate of potash per acre

This trial was begun as ratoons. As plant cane the area in which the trial is located had been treated with 4 cwts. sulphate of ammonia plus 3 cwts. 40% superphosphate per acre.

Experiments were initiated during 1962 to determine the relative merit of root and leaf as an indicator of fertilizer utilization. The experiments are in progress and at present only preliminary data are presented.

From plots which had received various

fertilizer treatments (Table 5), entire stools were removed, leaves and roots were severed and analyzed for N, P, and K. Root and leaf analyses were carried out one week prior to the application of fertilizer, one week following application, and thereafter at two week intervals. Preliminary results are presented in Table 5.

Table 5
Results of Plant Analysis — Leaves and Roots
La Fortunee B.V. 37
(Age of cane at initial sampling was six weeks)

Nitrogen %

Treatments per acre	Time in days before and after fertilizer applications					
	7 Before		7 After		21	After
	Leaves	Roots	Leaves	Roots	Leaves	Roots
Control — nil	1.51	0.32	1.58	0.96	1.88	1.03
2 cwts. Sulphate of Ammonia	1.60	0.20	1.59	1.08	2.64	1.21
4 cwts. Sulphate of Ammonia	1.60	0.29	1.89	1.06	2.28	1.23
4 cwts. Sulphate of Ammonia + 2 cwts. Muriate of Potash	1.47	0.26	1.53	1.25	2.58	1.20
2 cwts. Calcium ammonium nitrate	1.57	0.29	2.06	1.18	2.39	1.48
4 cwts. Calcium ammonium nitrate	1.58	0.38	2.13	1.11	2.50	1.28
4 cwts. Calcium ammonium nitrate + 2 cwts. Muriate of Potash	1.62	0.28	2.12	1.10	2.41	1.33
Rainfall for week preceding sampling	0.75		5.37		0.75	

Phosphate %

Treatments per acre	Time in days before and after fertilizer applications					
	7 Before		7 After		21	After
	Leaves	Roots	Leaves	Roots	Leaves	Roots
Control — nil	0.25	0.14	0.30	0.28	0.39	0.20
2 cwts. Sulphate of Ammonia	0.31	0.14	0.26	0.28	0.38	0.17
4 cwts. Sulphate of Ammonia	0.29	0.13	0.25	0.25	0.35	0.18
4 cwts. Sulphate of Ammonia + 2 cwts. Muriate of Potash	0.31	0.14	0.23	0.29	0.38	0.17
2 cwts. Calcium ammonium nitrate	0.28	0.13	0.25	0.26	0.36	0.20
4 cwts. Calcium ammonium nitrate	0.33	0.15	0.30	0.33	0.37	0.17
4 cwts. Calcium ammonium nitrate + 2 cwts. Muriate of Potash	0.29	0.16	0.24	0.24	0.37	0.18
Rainfall for week preceding sampling	0.75		5.37		0.75	

Table 5 (Continued)

Potash %

Treatments per acre	Time in days before and after fertilizer applications					
	7 Before		7 After		21	After
	Leaves	Roots	Leaves	Roots	Leaves	Roots
Control — nil	2.52	1.21	1.54	0.94	1.18	0.80
2 cwts. Sulphate of Ammonia	2.46	1.07	1.48	0.98	1.28	0.78
4 cwts. Sulphate of Ammonia	2.13	1.02	1.68	0.97	1.26	0.96
4 cwts. Sulphate of Ammonia + 2 cwts. Muriate of Potash	2.52	1.14	1.90	1.08	1.10	0.88
2 cwts. Calcium ammonium nitrate	2.40	1.21	1.40	0.93	1.10	0.90
4 cwts. Calcium ammonium nitrate	2.38	1.24	1.60	0.96	1.02	0.76
4 cwts. Calcium ammonium nitrate + 2 cwts. Muriate of Potash	2.34	1.21	1.50	0.95	1.22	0.88
Rainfall for week preceding sampling	0.75		5.37		0.75	

Table 6.

Total shoot lengths (in centimeters) of canes grown on Talparo Clay, Princes Town Marl, and Sevilla Clay at Reform and at Ste. Madeleine

Treatment	First Measurement		Second Measurement		Third Measurement	
	After 16 weeks		After 21 weeks		After 30 weeks	
	U.S.M.	Reform	U.S.M.	Reform	U.S.M.	Reform
Talparo clay — nil	1397	1123	1637	1444	2484	1890
Talparo clay + N	1312	976	2133	1794	3695*	3236*
Talparo clay + N + P	1244	1256	1951	1954	3388*	3313
Princes Town marl — nil	1225	654	1277	728	1163	1061
Princes Town marl + N	1751	1491*	3681*	2057	2856*	2598*
Princes Town marl + N + P	1614	1616*	2582*	2532*	3293*	2608*
Sevilla clay — nil	1798	739	2301	823	2641	1187
Sevilla clay + N	2103	1835*	3166	2610*	4070*	3224*
Sevilla clay + N + P	2259	1894*	3316	2979*	4197*	3160*
L.S.D. $P = 0.05$	529	764	1258	1702	1371	914

* Differences between "nil" and fertilizer treatments were significant at .05 level.

Table 7
Summary of growth measurements (see Table 6)

Treatment	First Measurement		Second Measurement		Third Measurement	
	16 weeks		21 weeks		30 weeks	
	U.S.M.	Reform	U.S.M.	Reform	U.S.M.	Reform
Talparo clay	3953	3355	5721	5192	9567	8489
Princes Town marl	4500*	3761	6540	5317	7312*	6267*
Sevilla clay	6160*	4468	8783*	6412	10908	7571
L.S.D. $P = 0.05$	508	1630	890	1656	1575	1102

* Differences between growth of plants grown on Talparo Clay and other soils were significant at .05 level.

Table 8

Foliar Analysis — Per cent Nitrogen, Phosphorus, and Potash in leaves collected from plants growing in containers holding the three different types of soils

Treatment	Ste. Madeleine			Reform		
	% N	% P	% K	% N	% P	% K
Talparo clay — nil	1.95	0.278	1.89	1.44	0.243	1.03
Talparo clay + N	2.25	0.213	1.56	1.98	0.278	0.96
Talparo clay + N + P	2.07	0.177	1.48	2.02	0.265	0.94
Princes Town marl — nil	1.28	0.197	1.48	1.47	0.280	0.88
Princes Town marl + N	1.82	0.192	1.73	1.40	0.185	0.79
Princes Town marl + N + P	1.62	0.187	1.57	1.76	0.225	0.97
Sevilla clay — nil	1.60	0.217	1.64	1.38	0.295	0.92
Sevilla clay + N	1.95	0.183	1.51	1.71	0.230	0.84
Sevilla clay + N + P	2.00	0.192	1.67	1.76	0.210	0.90
Mean	1.84	0.204	1.61	1.66	0.246	0.91

It is of interest to note (Table 5) that N levels in both leaves and roots taken from control plots rose sharply "7 days after" application of fertilizer, even though these particular plots did not receive a fertilizer dressing. Particularly striking is the amount of N detected in the roots collected from the control plots. The rapid uptake of N may have coincided with the growth of root initials at this stage of cane development. In spite of the relatively high levels of N in control roots, there was a greater percentage of N in roots taken from plots which 7 days previously had received various dressings of nitrogenous fertilizers. Interestingly, the root tissues appear to give a more marked response to fertilizer, in terms of uptake of N, than do the leaf tissues. With respect to phosphate, the leaf tissues showed a depression in per cent P at 7 days following applications of nitrogenous fertilizers, while root tissues indicated a marked rise in P levels. Whether or not this is due to uptake of P by roots and the absence of translocation of the elements from the roots to the leaves, remains to be determined. Potash levels in leaves also dropped sharply at 7 days after the fertilizers were applied, but a drop was also noted in controls. A decrease in potash levels of roots was also recorded, but this was not as striking as in the case of leaves. If the levels of potash in the tissues were being regulated by the amount of rainfall incident on the plots prior to sampling, one would have expected also that the mobility of nitrogen would have been affected — but this was not the case. The preliminary data suggest that root tissues, sampled early in their development, might afford a preliminary indication of nutritional status and in some cases might be of more value than foliar analyses.

g. Agricultural Factors Affecting Relative Juice Qualities at Reform and Ste. Madeleine Factories

Traditionally, better rendement of canes has been obtained at Reform factory than at the Ste. Madeleine Factory. Although this may be due to differences in factory efficiencies as influenced by the size of the factory operation, we are investigating agricultural variables which might account for the phenomenon.

One of the important agricultural variables is soil type. At Ste. Madeleine factory most of the cane received there is grown on Talparo clay or Princes Town marl, while at Reform very little cane grown on Princes Town marl enters the factory. At Reform most of the cane is grown on Sevilla clay or Talparo clay.

In two experiments, one of which was established in the Reform area and another in the area of Ste. Madeleine, cane (B 49119) is being grown to maturity in drums containing 300 lbs. of Talparo clay, Princes Town marl, and Sevilla clay. Each of the soil types was treated with two different formulations of fertilizer a) sulphate of ammonia 4 cwt. per acre, b) sulphate of ammonia 4 cwt. per acre plus superphosphate (40%) 3 cwt. per acre. A series of the soils did not receive any fertilizer treatments and served as a control. To date the following data have been recorded: 1) total shoot lengths (Table 6), foliar analyses (Table 8), soil nitrogen, phosphate, and potash (Tables 9, 10, and 11).

As may be noted in Table 6, plants grown on Sevilla clay showed an earlier response to fertilizer than plants grown on Talparo clay. However, at 30 weeks after planting all plants had responded to fertilizer in each of the soil types. The growth responses were more marked in soils treated with N or N + P, than in soils treated with P alone. If the lack of response to P continues, it may indicate that a similar situation exists in the field, especially in areas where these particular soils predominate. Actually in fertilizer trials, described earlier in this report, lack of responses to P were, in fact, noted.

Table 7 contains a summary of growth measurements and responses based on differences in soil type rather than on differences in fertilizer treatments. At 16 and 21 weeks, plants grown on Sevilla clay showed a greater total shoot elongation than plants grown on Talparo clay or Princes Town marl. Sevilla clay is generally regarded as one of the poorer soils at Ste. Madeleine, but with better sub-soil drainage (as exists in the drums) this soil might prove more productive.

Foliar analyses of leaves collected from the two experiments are summarized in Table 8. Confirming the growth responses to fertilizers (Table 6), the foliar analyses (Table 8) revealed that the percentage of P in controls was not significantly greater than in leaves collected from plants grown in fertilized soils. In general, at the Ste. Madeleine location, potash levels in leaves were higher than at Reform. This difference may have accounted for the more marked growth rate of plants grown at the Ste. Madeleine location (Table 7). If one compares the foliar levels for N, P, K recorded in Table 8 with the levels considered adequate (i.e. N 1.50 to 2.40, P 0.16 to 0.24, and K 0.90 to 1.40) we find that leaf nitrogen was adequate, phosphate was also adequate (irrespective of whether phosphate was applied to the soils or

not), but potash levels at Reform were generally applied, below the adequate range.

Soil analyses (N, P, and K) were carried out also at both locations at two different times :

a) at time of filling the drums with the soils —prior to planting and before fertilizers were

b) seven months after planting, and at the same time that leaves were analyzed.

Results of the initial and 7-month analyses are presented in Tables 9, 10, and 11.

Table 9.
SOIL NITROGEN

Treatment	Ste. Madeleine		Reform	
	Months after planting		Months after planting	
	0	7	0	7
	<i>Per Cent.</i>	<i>Per Cent.</i>	<i>Per Cent.</i>	<i>Per Cent.</i>
Talparo clay — nil	0.36	0.38	0.42	0.39
Talparo clay + N	0.36	0.38	0.42	0.46
Talparo clay + N + P	0.36	0.40	0.42	0.45
Princes Town marl — nil	0.36	0.42	0.43	0.45
Princes Town marl + N	0.36	0.44	0.43	0.46
Princes Town marl + N + P	0.36	0.40	0.43	0.46
Sevilla clay — nil	0.36	0.37	0.42	0.43
Sevilla clay + N	0.36	0.39	0.42	0.47
Sevilla clay + N + P	0.36	0.36	0.42	0.46

Table 10
SOIL PHOSPHATE

Treatment	Ste. Madeleine		Reform	
	Months after planting		Months after planting	
	0	7	0	7
	<i>Per Cent.</i>	<i>Per Cent.</i>	<i>Per Cent.</i>	<i>Per Cent.</i>
Talparo clay — nil	0.0020	0.0016	0.0019	0.0016
Talparo clay + N	0.0020	0.0022	0.0019	0.0015
Talparo clay + N + P	0.0020	0.0030	0.0019	0.0020
Princes Town marl — nil	0.0003	0.0002	0.0002	0.0001
Princes Town marl + N	0.0003	0.0002	0.0002	0.0001
Princes Town marl + N + P	0.0003	0.0010	0.0002	0.0007
Sevilla clay — nil	0.0013	0.0011	0.0012	0.0009
Sevilla clay + N	0.0013	0.0005	0.0012	0.0007
Sevilla clay + N + P	0.0012	0.0019	0.0012	0.0016

Table 11.
SOIL POTASH

Treatment	Ste. Madeleine		Reform	
	Months after planting		Months after planting	
	0	7	0	7
	<i>Per Cent.</i>	<i>Per Cent.</i>	<i>Per Cent.</i>	<i>Per Cent.</i>
Talparo clay — nil	0.0169	0.0200	0.0164	0.0192
Talparo clay + N	0.0169	0.0132	0.0164	0.0153
Talparo clay + N + P	0.0169	0.0190	0.0164	0.0167
Princes Town marl — nil	0.0185	0.0194	0.0177	0.0193
Princes Town marl + N	0.0185	0.0187	0.0177	0.0175
Princes Town marl + N + P	0.0185	0.0164	0.0177	0.0177
Sevilla clay — nil	0.0131	0.0121	0.0122	0.0108
Sevilla clay + N	0.0131	0.0130	0.0122	0.0163
Sevilla clay + N + P	0.0131	0.0154	0.0122	0.0115

The analyses for N indicated that the three soils contained approximately equivalent amounts. At seven months after planting the soils which had received nitrogenous fertilizers, in general, contained more N than controls.

The content of P varied with the type of soil. Talparo clay at planting with 0.002% contained the greatest quantity of P, following by Sevilla clay (0.0013%), and Princes Town marl (0.003%). At seven months, those soils which had received phosphate fertilizer showed increases in the phosphate content of the soil, but, as stressed earlier, there were no significant growth responses of plants grown on such soils,

nor did the leaf analyses show increases in per cent P with increasing dosages of P fertilizer. It is doubtful that the superphosphate was available to the plants growing in these particular soils.

The K content of Sevilla clay was relatively low, but the level of this element in Talparo clay and Princes Town marl appeared to be adequate.

It is hoped that by a combination of fertilizer trials, foliar diagnoses, and soil analyses, coupled with periodic growth measurements, it shall be possible to determine the agricultural factors influencing rendement at Ste. Madeleine and Reform.

D. Weed Control

1. At Caroni Limited

I. D. Lawrie

A number of different types of weed investigations were conducted during the year. These may be enumerated as follows :

a. Field evaluation of newer pre-emergence herbicides which had shown promise in 1961 screening trials.

b. Further studies of atrazine and atrazine-2, 4-D mixtures as pre-emergence herbicides.

c. A long-range study of the effect of re-application of the substituted ureas and the symmetrical triazines on the quantitative and qualitative composition of the weed flora and

final yield of sugar cane.

d. The influence on yields of Karmex and simazine in combination with different 2,4-D formulations.

e. Screening of newer pre-emergence herbicides.

f. Large-scale plots demonstrating the relative effectiveness of Kuron, Atrazine-2,4-D, Karmex-2,4-D, and Pesco 1815 as pre-emergence treatments, and

g. The continuation of a weed survey begun in 1961.

a. Field Evaluation of Newer Pre-emergence Herbicides Which Had Shown Promise in 1961 Screening Trials

During 1961 an extensive screening programme of new herbicides was conducted to determine the efficacy of the newer materials (Ref. C.A.R.S.

Annual Report 1960-1961). Of the more promising compounds, the following were included in more extensive trials during 1962 :

(1) Fenac	—	2,3,6-trichlorophenylacetic acid
(2) Kuron	—	2, -(2,4,5 trichlorophenoxy) propionic acid, propylene glycol, butyl ether ester.
(3) Amiben	—	Triethyl amine salt of 3-amino-2,5-dichloro benzoic acid
(4) Pesco 1815	—	Trichlorobenzoic acid + 4,e methylchlorophenoxy-acetic acid
(5) Hercules 7175	—	-1-(chloro-2-norbonyl)-3,3-dimethyl urea
(6) Hercules 7531	—	-1-(5-(3a,4,5,6,7,7a-hexahydro-4,7-methanoindenyl))-3,3-dimethyl urea
(7) Alipur	—	Cyclooctyl-dimethyl urea + butinyl-m-dichlorophenyl carbamate
(8) Stam F 34	—	3,4 dichloropropionanilide

Further studies on Fenac and Kuron as pre-emergence herbicides in sugarcane

Fenac was evaluated at 2, 3, and 4 lbs. active per acre, while Kuron was tested at 3, 4, and 5 lbs. active per acre. Karmex and Atrazine were included as standards at 2.4 lbs. and 2.5 lbs. active per acre plus 0.63 lbs. per acre 2,4-D amine ("Fernamine"). All treatments were applied in 20 gallons of water per acre by means of knapsack sprayers fitted with 15006 Tee-jet nozzles. Results of the trial on Waterloo loam and clay are presented in Table 1.

Table 1.

Treatments in lbs. active ingredient per acre	Experiment I	
	Waterloo Estate 8	
	Waterloo loam & clay	
	No. of days after application	
	45	55
	% Weed Cover	
Control	45	93
Fenac 2 lbs./acre	10	10
Fenac 3 lbs./acre	10	10
Fenac 4 lbs./acre	10	10
Kuron 3 lbs./acre	10	15
Kuron 4 lbs./acre	10	25
Kuron 5 lbs./acre	10	10
Karmex 2.4 lbs./acre + 2,4-D amine 0.63 lb./ac.	13	15
Atrazine 2.5 lbs./acre + 2,4-D amine 0.63 lb./ac.	10	10
Sig. Diff. 5%	8	11
Accumulated Rainfall in inches	11.67	15.72

Fenac at 2, 3, and 4 lbs. active per acre provided excellent weed control up to 55 days, comparing favourably with the standards. Kuron at 5 lbs. active per acre controlled weeds as effectively as the standards, but the dosage rate required for effective control was approximately twice that of the Karmex or Atrazine. Growth measurements taken at 55 and 70 days after application of the herbicides indicated an early suppression of growth in plots treated with the highest dosages of Fenac and Kuron (Table 2). However, Fenac at the rates required for effective weed control did not suppress growth significantly, at 70 days after application (Table 2). Similarly, Karmex and Atrazine were not injurious.

Table 2.

Treatments in lbs. active ingredient per acre	Experiment I	
	Waterloo Estate 8	
	Waterloo loam & clay	
	No. of days after application	
	55	70
	Growth Measurements in cm.	
Control	109	140
Kuron 3 lbs./acre	105	144
Kuron 4 lbs./acre	103	139
Kuron 5 lbs./acre	97	133
Fenac 2 lbs./acre	100	138
Fenac 3 lbs./acre	98	136
Fenac 4 lbs./acre	91	122
Atrazine 2.5 lbs./acre + 2,4-D amine 0.63 lb./acre	114	147
Karmex 2.4 lbs./acre + 2,4-D amine 0.63 lb./acre	113	145
L.S.D. 5%	13	20

*Further studies on Amiben and Pesco 1815 as
pre-emergence herbicides in sugarcane*

Pesco 1815 and amiben were evaluated at 3, 4, and 5 lbs. active per acre on Mc Bean sand and loam and on Waterloo loam and clay (Table 3).

Table 3.

Treatments in lbs. active ingredient per acre	Experiment I				Experiment II		
	Mc Bean Est. 18				Waterloo Est. 51		
	McBean sand & loam				Waterloo loam & clay		
	No. of days after application				No. of days after application		
	66	76	86	95	23	31	45
	% Weed Cover				% Weed Cover		
Control	83	98	100	100	50	78	98
Pesco 3 lbs./acre	5	10	25	33	35	40	75
Pesco 4 lbs./acre	5	13	20	35	33	45	80
Pesco 5 lbs./acre	10	8	13	18	20	23	43
Amiben 3 lbs./acre	13	23	43	58	45	50	90
Amiben 4 lbs./acre	10	25	48	68	25	43	83
Amiben 5 lbs./acre	20	48	63	68	30	40	70
Karmex 2.4 lbs./acre + 2,4-D amine 0.63 lbs./ac.	0	0	0	8	10	13	28
Atrazine 2.5 lbs./acre + 2,4-D amine 0.63 lbs./ac.	13	35	55	75	30	30	63
Sig. Diff. 5%	13	29	42	38	38	45	45
Accumulated Rainfall in inches	12.49	17.37	18.92	19.60	5.85	8.45	11.56

Pesco 1815 gave excellent weed control on Mc Bean sand and loam, particularly at 5 lbs. active per acre. The results with the Pesco 1815 at 5 lbs.act./acre, 3 months after applications, were comparable to those given by Karmex-2,4-D mixture, and superior to the weed control provided by the atrazine-2,4-D mixture. Amiben, in comparison, provided poor weed control. On

Waterloo loam and clay, poorer results were obtained with all treatments, excepting Karmex-2,4-D, probably because some weeds had germinated prior to application of the herbicides (Table 3). No adverse effects on growth of the crop was recorded with any of the treatments (Table 4).

Table 4.

Treatments in lbs. active ingredient per acre	Experiment III	
	Mc Bean Est. 18	
	Mc Bean sand & loam	
	No. of days after application	
	52	79
	Growth measurements in cm.	
Control	99	145
Pesco 1815 3 lbs./acre	91	142
Pesco 1815 4 lbs./acre	91	141
Pesco 1815 5 lbs./acre	93	142
Amiben 3 lbs./acre	89	142
Amiben 4 lbs./acre	93	143
Amiben 5 lbs./acre	97	146
Karmex at 2.4 lbs./acre + 2,4-D amine at 0.63 lb./acre	90	137
Atrazine 2.5 lbs./acre + 2,4-D amine 0.63 lb./acre	93	147
L.S.D. 5%	17	21

*Further studies on Hercules 7175 and 7531 as
pre-emergence herbicides*

These two substituted urea herbicides were evaluated on Waterloo loam and clay and on Cunupia medium clay at 2.4, 3.2, and 4.0 lbs. active per acre (Table 5).

Table 5.

Treatments in lbs. active ingredient per acre	Experiment I				Experiment II		
	Perseverance No. 114				Brechin Castle Est. 1		
	Waterloo loam & clay				Cunupia medium clay		
	No. of days after Application				No. of days after application		
	40	48	57	67	20	31	47
	% Weed Cover				% Weed Cover		
Control	70	100	100	100	58	100	100
Karmex 2.4 lbs./acre + 2,4-D amine 0.63 lb./ac.	10	20	40	73	5	10	43
Hercules 7175 2.4 lbs./ac.	8	13	18	53	8	30	73
Hercules 7175 3.2 lbs./ac.	10	15	15	58	10	20	78
Hercules 7175 4.0 lbs./ac.	13	20	18	40	13	28	70
Hercules 7531 2.4 lbs./ac.	18	35	48	75	10	25	83
Hercules 7531 3.2 lbs./ac.	18	35	43	70	8	15	65
Hercules 7531 4.0 lbs./ac.	10	28	33	63	8	10	50
Atrazine 2.5 lbs./acre + 2,4-D amine 0.63 lb./ac.	10	10	18	53	8	10	73
Sig. Diff. 5%	9	20	24	34	9	18	50
Accumulated Rainfall in inches	11.70	15.26	19.21	23.69	4.60	8.75	13.39

On Waterloo loam and clay, Hercules 7175 gave better results than Hercules 7531 and the standard Karmex-2,4-D mixture (Table 5). However on Cunupia medium clay there were no significant differences between the test herbicides, and at 47 days after application none of the treat-

ments had effectively controlled weeds. The latter result might have been due to a growth of weeds in the field prior to planting and before the application of treatments. There were no adverse effects on initial growth of the crop (Table 6).

Table 6.

Treatments in lbs. active ingredient per acre	Experiment II	
	Perseverance No. 114	
	Waterloo loam & clay	
	No. of days after application	
	54	75
	Growth measurements in cm.	
Control	122	161
Hercules 7531 2.4 lbs./ac.	106	156
Hercules 7531 3.2 lbs./ac.	120	166
Hercules 7531 4.0 lbs./ac.	107	157
Hercules 7175 2.4 lbs./ac.	110	155
Hercules 7175 3.2 lbs./ac.	118	166
Hercules 7175 4.0 lbs./ac.	114	163
Atrazine 2.5 lbs./ac. + 2,4-D amine 0.63 lb./ac	109	164
Karmex 2.4 lbs./ac + 2,4-D amine 0.63 lb./ac	107	162
L.S.D. 5%	18	19

*Further studies on Alipur and Stam-34
as pre-emergence herbicides*

Alipur at 3, 4, and 5 lbs. active per acre and Stam-34 at 3, and 6 lbs. active per acre applied singly and in combination with 0.63 lbs. per acre, 2,4-D amine did not control weeds as

effectively as the standard Karmex-2,4-D and Atrazine-2,4-D mixtures (Table 7). The experiments were conducted on Freeport clay and on the Cunupia-Sevilla-Basseterre series.

Table 7

Treatments in lbs. active ingredient per acre	Experiment I			Experiment II		
	Wyaby C.W. 16			Esperanza P.G. 19		
	Freeport clay			Cunupia, Sevilla, Basseterre series		
	No. of days after application			No. of days after application		
	30	40	49	24	33	44
	% Weed Cover			% Weed Cover		
Control	83	100	100	38	85	100
Alipur 3 lbs./acre	38	60	80	20	28	78
Alipur 4 lbs./acre	28	48	78	35	45	75
Alipur 5 lbs./acre	33	53	75	28	53	73
Stam F 34 3 lbs./acre	70	98	100	20	48	93
Stam F 34 6 lbs./ac.	65	85	95	13	40	88
Stam F 34 6 lbs./acre + 2,4-D amine 0.63 lb./acre	65	83	93	13	25	63
Stam F 34 4 lbs./acre + 2,4-D amine 0.63 lb./acre	73	100	100	10	18	65
Karmex 2.4 lbs./acre + 2,4-D amine 0.63 lb./acre	8	13	25	10	15	40
Atrazine 2.5 lbs./acre + 2,4-D amine 0.63 lb./acre	15	20	35	18	25	43
sig. Diff. 5%	53	42	39	35	59	47
Accumulated Rainfall in inches	9.77	13.71	17.72	5.40	10.27	15.72

b. Further evaluation of Atrazine as a Pre-emergence Herbicide in Plant Cane

Atrazine was evaluated at rates of 2.0 and 2.5 lbs. active per acre applied singly and in combination with 2,4-D amine at 0.63 lbs. active per acre. In addition, atrazine at 2.5 lbs. active plus 2,4-D (dimethylamine ester-DMA 6) at 0.63 lbs. active per acre was included in the two trials. These treatments were compared with Karmex 2.4 lbs. active plus 2,4-D amine 0.63 lbs. active per acre. In the trial on Frederick Very Heavy Clay, atrazine (2.5 lbs. active) applied

singly, and the atrazine-2,4-D combination, provided better control than the Karmex-2,4-D mixture (Table 8). There were no statistically significant differences between the various treatments containing atrazine. On Couva loam and clay, at 44 days after application, there were statistically significant differences between Karmex-2,4-D, the control and the atrazine treatments applied singly (Table 8).

Table 8.

Treatments in lbs. active ingredient per acre	Experiment I					Experiment II		
	Curepe Fred. 137					Brechin Castle Est. 50		
	Frederick Very Heavy Clay					Couva Loam & Clay		
	No. of days after application					No. of days after application		
	45	55	63	73	84	26	34	44
	% Weed Cover					% Weed Cover		
Control	68	95	98	98	100	25	83	100
Atrazine 2.0 lbs./acre	10	35	38	48	65	28	58	75
Atrazine 2.5 lbs./acre	10	13	20	23	35	18	55	78
Atrazine 2.0 lbs./acre + 2,4-D amine 0.63 lb./acre	10	15	20	25	45	13	28	55
Atrazine 2.5 lbs./acre + 2,4-D amine 0.63 lb./acre	10	13	18	28	38	13	33	58
Karmex 2.4 lbs./acre + 2,4-D amine 0.63 lb./acre	30	65	73	80	90	10	20	30
Atrazine 2.5 lbs./acre + DMA-6 0.63 lb./acre	8	15	18	23	35	13	38	63
Sig. Diff. 5%	17	25	27	32	25	16	35	36
Accumulated Rainfall in inches	16.12	18.91	20.19	22.96	25.23	7.55	11.42	13.59

c. A Long-Range Study of the Effect of Re-Application of the Substituted Ureas and the Symmetrical Triazines on the Quantitative and Qualitative Composition of the Weed Flora and Final Yield of Sugarcane

Five experiments are underway to determine, over several years, the effect on the composition of the weed flora of re-applying the same herbicides to a given area. In addition it is the objective of such experiments to study the long-range effects of the herbicides on yields of cane. The chemicals under test are Karmex, Karmex + 2,4-D, Simazine, Simazine + 2,4-D, and Dowpon + 2,4-D. Trials were begun in 1961 when the herbicides were applied as pre-emergence sprays in plant cane. During 1962 the compounds were re-applied to the same plots immediately after reaping and removal of trash and prior to germination of the first ratoons.

In four of the five trials, those plots which had been treated with Karmex and/or Karmex

plus 2,4-D amine produced the greatest yields (Table 9). Simazine and simazine plus 2,4-D plots outyielded controls in four of the experiments and equalled the yields in plots treated with Dowpon-2,4-D. The relatively low yields experienced in Experiment 1 (Table 9) were the direct result of a severe froghopper infestation.

The effect of the various treatments on control of weeds was quite marked (Table 10). Karmex and Karmex + 2,4-D provided the best residual control followed by simazine + 2,4-D, and simazine used singly. Treatments containing Karmex or simazine were significantly better than the Dowpon-2,4-D mixtures (Table 10).

Table 9

Treatments in lbs. active ingredient per acre	Experiment I			Experiment II			Experiment III			Experiment IV			Experiment V		
	Washington Fred. 22			Perseverance Ed. B.2			B.C. Est. 51			McBean Estate 11			Felicite 16W 4		
	Cunupia medium clay			Waterloo loam & clay			Couva loam & clay			McBean sand & loam			Frederick V.H. Clay		
	TC/A	TC/TS	TS/A	TC/A	TC/TS	TS/A	TC/A	TC/TS	TS/A	TC/A	TC/TS	TS/A	TC/A	TC/TS	TS/A
Control	4.12	9.34	.45	18.91	9.32	2.03	25.08	9.16	2.73	24.71	8.53	2.92	29.94	10.48	2.86
Karmex at 3.2 lbs.	10.32	9.11	1.13	31.50	8.82	3.57	31.41	8.92	3.54	25.90	8.78	2.95	31.89	10.28	3.10
Karmex at 2.4 lbs. + 2,4-D Amine at 0.63 lb.	9.70	8.63	1.12	27.66	9.17	3.03	31.64	8.86	3.57	24.81	8.90	2.79	29.33	10.29	2.85
Dowpon at 3.4 lbs. + LV6 at 1.35 lb.	7.40	9.09	.82	26.29	8.95	2.94	29.55	9.02	3.26	23.88	8.90	2.69	29.34	10.58	2.77
Simazine at 3 lbs.	10.61	9.36	1.14	26.02	9.23	2.83	16.05	9.09	2.87	24.13	9.03	2.72	30.92	10.52	2.94
Simazine at 2.5 lbs + 2,4-D Amine at 0.63 lb.	9.09	9.07	1.00	26.62	9.09	2.93	28.63	8.86	3.25	24.75	9.22	2.69	29.97	10.24	2.93
L.S.D. at 5%	2.50	0.61	0.28	3.29	0.62	0.48	—	—	0.75	—	0.63	—	—	—	—
L.S.D. at 1%	3.45	0.84	0.39	4.49	0.86	0.67	—	—	—	—	—	—	—	—	—

Table 10

Treatments in lbs. active ingredient per acre	Experiment I		Experiment II		Experiment III			Experiment IV	
	Perseverance 2 Ed. B.		Brechin Castle Est. 51		Mc Bean Estate 11			Washington Fred. 22	
	Waterloo loam & clay		Couva loam & clay		Mc Bean sand & loam			Cunupia medium clay	
	No. of days after application		No. of days after application		No. of days after application			No. of days after application	
	18	32	22	36	36	60	70	50	72
	% Weed Cover		% Weed Cover		% Weed Cover			% Weed Cover	
Control	58	90	85	100	83	100	100	55	88
Karmex 3.2 lbs./acre	5	10	13	23	0	0	8	5	8
Karmex 2.4 lbs./acre + 2,4-D amine 0.63 lb./acre	3	5	10	20	0	3	10	3	10
Simazine 3 lbs./acre	15	13	18	33	5	48	68	10	28
Simazine 2.5 lbs./acre + 2,4-D amine 0.63 lb./acre	5	10	18	30	3	30	53	10	18
Dowpon 3.4 lbs./acre + LV 6 1.35 lb./acre	18	53	28	80	45	98	100	28	85
Sig. Diff. 5%	16	18	24	27	14	22	16	25	25
Accumulated Rainfall in inches	7.40	12.10	8.18	12.52	5.58	20.43	25.87	8.08	18.75

d. *The Influence on Yields of Karmex and Simazine in Combination with Different 2,4-D Formulations*

In a replicated trial on Sevilla Clay (Table 11) it was found that yields were not adversely affected by Karmex and Simazine in combination with various formulations of 2,4-D.

Table 11

Treatments in active ingredient per acre	Brechin	Castle	Estate 12
	Sevilla Clay		
	TC/A	TC/TS	TS/A
Karmex at 2.4 lbs. + LV6 at 0.90 lb.	27.68	10.50	2.66
Karmex at 2.4 lbs. + Fernamine at 0.63 lb.	27.64	10.06	2.77
Karmex at 2.4 lbs. + Planotox at 0.88 lb.	27.12	10.06	2.81
Karmex at 2.4 lbs. + Weedazol TL at 1.0 lb.	25.87	10.80	2.40
Simazine at 2.5 lbs. + LV 6 at 0.90 lb.	26.73	10.31	2.63
Simazine at 2.5 lbs. + Fernamine at 0.63 lb.	28.91	10.80	2.74
Simazine at 2.5 lbs. + Planotox at 0.88 lb.	24.90	10.01	2.50
Simazine at 2.5 lbs. + Weedazol TL at 1.0 lb.	27.45	10.79	2.55
Simazine at 2.5 lbs. + Dowpon at 3.4 lbs.	26.91	11.11	2.44
Control	25.05	10.05	2.52
L.S.D. at 5%	—	—	—
L.S.D. at 1%	—	—	—

e. *Screening of Newer Pre-Emergence Herbicides*

Five new herbicides were screened in small-scale field trials during 1962. The formulae of the compounds under test are presented in Appendix 76. The herbicides screened as pre-emergence applications were as follows: CP 31675, Lorox, Hyvar, WL 5792, and ACP 62-74. They all provided promising weed control. Severe injury to cane was caused by Hyvar, but weed control was spectacular, and a reduced dosage might alleviate the phytotoxicity. Detailed results of the screening trials are presented in Tables 12 and 14.

Unfortunately the results presented in Table 13 are inconclusive, as the trial was hand-weeded accidentally at 54 days after application of the treatments. Relatively few weeds (40% weed cover) emerged in the control plots.

Lorox at 3 lbs. active per acre on Freeport clay (Table 12) performed as well as the standards (i.e. Karmex-2,4-D, atrazine + 2,4-D), and, at this dosage rate, represents a relatively economical treatment. Hyvar at 3 lbs. active per acre also compared favourably with the standards, but the compound was injurious to the crop (Table 12). WL 5792 at 4 lbs. active per acre was as effective as atrazine + 2,4-D on Waterloo loam and clay (Table 13), and further work with this compound is indicated. CP 31675 and ACP 62-74 at 3 and 2.4 lbs. active per acre, respectively, also exhibited long residual activity (70 to 80 days) and were as effective as either of the standards (Table 14). Further studies with CP 31675 and ACP 62-74 are to be continued during 1963.

Table 12

Treatments in lbs. active ingredient per acre	Wyaby C.W. 16		
	Freeport Clay		
	No. of days after application		
	30	40	49
	% Weed Cover		
Lorox 1 lb./acre	25	70	100
Lorox 2 lbs./acre	0	10	25
Lorox 3 lbs./acre	5	10	25
Hyvar 3 lbs./acre	5	10	20
Hyvar 6 lbs./acre	0	0	0
Hyvar 9 lbs./acre	0	0	0
Karmex 2.4 lbs./acre + 2,4-D amine 0.63 lb./acre	0	5	20
Atrazine 2.5 lbs./acre + 2,4-D amine 0.63 lb./acre	5	5	30
Control	25	60	90
Accumulated Rainfall in inches	9.79	13.71	17.72

Table 13

Treatments in lbs. active ingredient per acre	Exchange Dev. 32	
	Waterloo Loam & Clay	
	No. of days after application	
	44	54
	% Weed Cover	
Control	20	40
WL 5792 2 lbs./acre	20	30
WL 5792 4 lbs./acre	10	10
WL 5792 6 lbs./acre	10	10
Karmex 2.4 lbs./acre + 2,4-D amine 0.63 lb./acre	5	5
Atrazine 2.5 lbs./acre + 2,4-D amine 0.63 lb./acre	5	10
Accumulated Rainfall in inches	14.36	17.85

This trial was accidentally weeded by the Estate.

Table 14.

Treatments in lbs. active ingredient per acre	Phoenix Park Px. 12			
	Cunupia-Sevilla Soil Assoc.			
	No. of days after application			
	48	59	70	80
	% Weed Cover			
CP. 31675 1 lb./acre	10	25	45	70
CP. 31675 2 lbs./acre	15	25	45	65
CP. 31675 3 lbs./acre	15	15	30	45
ACP 62-74 1.2 lb./acre	15	20	30	55
ACP 62-74 2.4 lbs./acre	20	30	35	50
ACP 62-74 4.8 lbs./acre	10	10	15	35
Karmex 2.4 lbs./acre + 2,4-D amine 0.63 lb./acre	20	25	35	50
Atrazine 2.5 lbs./acre + 2,4-D amine 0.63 lb./acre	20	30	45	70
Accumulated Rainfall in inches	14.91	19.02	25.39	30.41

Unfortunately control plots were not included in the trial, but at least the efficacy of the new compounds may be compared with Karmex + 2,4-D and Atrazine + 2,4-D.

f. *Large-Scale Plots Demonstrating the Relative Effectiveness of Kuron, Atrazine-2,4-D, Karmex-2,4-D, and Pesco 1815 as Pre-Emergence Herbicides*

During the year, in co-operation with the Agricultural Superintendent at Caroni Limited, large-scale plots were treated with several pre-emergence herbicides. In demonstration plots on Mc Bean sand and loam, Pesco 1815 at 4 lbs. active per acre controlled weeds for over a *five month period!* At present prices Pesco 1815 (4 lbs. active) represents the most economical pre-emergence herbicide for use on Mc Bean sand and loam. Good weed control was also

provided by atrazine (2.5 lbs. active) - 2,4-D (0.63 lb. active), Karmex (2.4 lbs.) - 2,4-D amine (0.63 lbs.) and Kuron (4 lbs. active), but at the dosages required for best results all of these represent more expensive treatments than Pesco. At present there are a number of herbicides which may be used as pre-emergence treatments in sugarcane. The choice of which chemical should be used narrows down to cost-performance data.

g. *The Continuation of a Weed Survey Begun in 1961*

A weed survey was begun in 1961, and was continued in 1962, to determine any changes in the composition of the weed flora which may have occurred since a similar survey was completed by Blackburn, Hanschell, and Clarke several years ago. Weed specimens are being collected from the same fields which were sur-

veyed in previous years. When the survey is completed it should be possible to assess the extent of the ecological change on many fields at Caroni Limited from a predominantly broad-leaved flora to one composed today chiefly of grasses.

Recommendations

Pre-Emergence Weed Control in Plants

On the basis of weed control experiments conducted over a three year period, anyone of the following treatments is recommended for pre-emergence weed control in plant cane at Caroni Limited.

(1) A mixture of Karmex 2.4 lbs. active per acre plus 2,4-D amine 0.63 lb. active per acre in 20 gallons of water per acre, or

(2) *A mixture of atrazine 2.5 lbs. active

per acre plus 2,4-D amine 0.63 lb. active per acre in 20 gallons of water per acre.

*It is essential that atrazine + 2,4-D be applied to a completely weed-free surface.

(3) On Mc Bean sand and loam and on Waterloo loam and clay, it is recommended that Pesco 1815 at 4 lbs. active per acre be compared with the standard Estate practice on a more extensive acreage.

D. Weed Control (continued)

2. At Ste. Madeleine

F. B. Little

E. M. Johnson

a. Pre-Emergence Weed Control in Plant Cane.

A number of pre-emergence compounds were evaluated in plant cane at Ste. Madeleine. These were Lorox, Hyvar, Kuron, Fenac, Pesco 1815, Dowpon, Amiben (liquid and granular), Simazine (granular), Monsanto's CP 522 and Shell's WL 5792. Each of the new compounds was compared with the standard Karmex and Atrazine treatments.

Lorox and Hyvar

Lorox (3-(3,4-dichlorophenyl-1-methoxy-1-methyl urea) is formulated as a 50% wettable powder. In the present trials it was evaluated at 1.5 and 2.0 lbs. active per acre on Sevilla Clay (Table 1). At 2 lbs. per acre Lorox was as effective as the standards (i.e. Karmine and atrazine + gramoxone). Weeds were controlled for up to 97 days with a single application.

Hyvar (5-bromo-3-isopropyl-6-methyl uracil) provided excellent weed control, acting almost as a soil sterilant, but unfortunately at 2.4 and 4.0 lbs. active per acre the compound was injurious to cane (Table 1). Shoot counts taken at two months after application confirmed that growth of the crop had been suppressed. These results were similar to those obtained at Caroni Limited.

Fenac, Pesco 1815, Kuron, Amiben and Dowpon

Fenac (2,3,6-trichlorophenylacetic acid), Pesco 1815 (MCPA + trichlorobenzoic acid), and Kuron (2-2,4,5-trichlorophenoxy propionic acid) were evaluated as pre-emergence treatments in two trials, one located on an alluvial black soil and a second on Sevilla clay (Tables 2 and 3).

At 2, 3, and 4 lbs. active per acre Fenac was as effective as the standards, up to 65 days after application (Table 2). Similarly, Kuron at 4 and 5 lbs. per acre proved as effective as Karmine or atrazine + gramoxone. Pesco 1815 at 2.5 lbs. active per acre was as effective as other treatments on alluvial black soil (Table 2), but judging from results at Caroni Limited the compound should have been used at 4.0 lbs. active per acre to obtain better results. Nevertheless, the results with 2.5 lbs. per acre are encouraging and do indicate that further trials would be worthwhile. On Sevilla clay (Table 3) excellent weed control was given by 3 lbs. active per acre Fenac up to 56 days after a single application. There were no significant differences between Amiben (4 lbs.), Kuron (5 lbs.), Pesco 1815 (2 lbs.), Dowpon (4.5 + 1.8 lbs. 2,4-D ester), and the standards. On a cost performance basis Pesco 1815 at 2 lbs. active per acre was the outstanding treatment (i.e. \$6.00 (BWI) per acre for chemical costs).

TABLE 1

*Pre-emergence Treatments in Plant Cane.
Comparison of Hyvar and Lorox with standards (Karmex and Atrazine)*

<i>Location :</i>	Reform H.H.7	<i>Variety :</i>	B 49119
<i>Design :</i>	8 x 4 Randomised Blocks	<i>Planted :</i>	30/5/62
<i>Plot Size :</i>	1/40th Acre	<i>Applied :</i>	31/5/62
<i>Soil Type :</i>	Sevilla clay		

(A) Per cent Weed Cover — Days after Application

Treatment Herbicide (active ingredient per acre)	Percent Weed Cover— Days after Application	
	72	97
Control — nil	50	65
2.4 lbs. Karmex + 0.6 lb. 2,4-D amine	15*	20*
2.5 lbs. Atrazine + 0.25 lb. Gramoxone	15*	23*
2.4 lbs. Hyvar	0*	3*
4.0 lbs. Hyvar	3*	3*
1.5 lbs. Lorox	18*	33*
2.0 lbs. Lorox	10*	18*
1.5 lbs. Lorox + 0.8 lbs. 2,4-D amine	18*	25*
L.S.D. (P = 0.05)	16	24

* Differences between control and treatment were statistically significant. Hyvar had a severe effect on cane growth as discussed above. To measure this, a shoot count was taken two months after application.

(B) Shoot Count

Treatment	Total Shoots
Control — nil	3,331
2.4 lbs. Karmex + 0.6 lb. 2,4-D amine	6,437
2.5 lbs. Atrazine + 0.25 lb. Gramoxone	3,637
2.4 lbs. Hyvar	2,218
4.0 lbs Hyvar	2,741
1.5 lbs. Lorox	4,134
2 lbs. Lorox	3,083
1.5 lbs. Lorox + 0.8 lb. 2,4-D amine	3,322
L.S.D. (P = 0.05)	2,521

Table 2.

Pre-emergence Treatments in Plant Cane. Comparison of Fenac, Pesco 1815, and Kuron with standards (Karmex and Atrazine)

<i>Location :</i>	Picton W. 11	<i>Variety :</i>	B 49119
<i>Design :</i>	12 x 4 Randomised Blocks	<i>Planted :</i>	11/7/62
<i>Plot Size :</i>	1/40th Acre	<i>Applied :</i>	19/7/62
<i>Soil Type :</i>	Alluvial Black		

Percent Weed Cover — Days after Application

Treatment Herbicide (active ingredient per acre)	Percent Weed Cover— Days after Application		
	23	47	65
Control — nil	65	95	100
2.4 lbs. Karmex + 0.6 lb. 2,4-D amine	10*	15*	35*
2.5 lbs. Atrazine + 0.25 lbs. Gramoxone	20*	15*	35*
2 lbs. Fenac	25*	30*	55*
3.0 lbs. Fenac	15*	25*	45*
4.0 lbs. Fenac	10*	15*	30*
1.5 lbs. Pesco 1815	15*	30*	70
2 lbs. Pesco 1815	15*	40*	75
2.5 lbs. Pesco 1815	15*	30*	60
4 lbs. Kuron	5*	20*	55*
5 lbs. Kuron	5*	5*	15*
Control	70	95	100
L.S.D. (P = 0.05)	25	30	45

* Differences between controls and treatments were statistically significant.

Table 3

Pre-emergence Treatments in Plant Cane.
Comparison of Dowpon, Fenac, Pesco 1815, Kuron and Amiben with standards
(Karmex and Atrazine)

<i>Location :</i>	Reform H.H.36	<i>Variety :</i>	B 41227
<i>Design :</i>	10 x 5 Randomised Blocks	<i>Planted :</i>	26/7/62
<i>Plot Size :</i>	1/40th Acre	<i>Applied :</i>	30/7/62
<i>Soil Type :</i>	Sevilla clay		

This field had a 100% cover of weeds before planting. The weeds were cutlassed and both banks broken at planting. Under these conditions a heavy weed growth could be expected after planting.

Percent Weed Cover — Days after Application

Treatment Herbicide (active ingredient per acre)	Percent Weed Cover— Days after Application	
	42	56
Control — nil	72	88
2.4 lbs. Karmex + 0.6 lb. 2,4-D amine	36*	56
2.4 lbs. Karmex + 0.6 lb. 2,4-D amine + 2 pints Albolineum	44	56
2.5 lbs. Atrazine + 0.5 lbs. Gramoxone	32*	60
2.5 lbs. Atrazine + 1.8 lbs. 2,4-D ester	34*	64
4.5 lbs. Dowpon + 1.8 lbs. 2,4-D ester	30*	54
3 lbs. Fenac	12*	14*
2 lbs. Pesco 1815	20*	34*
5 lbs. Kuron	16*	38*
4 lbs. Amiben	24*	32*
L.S.D. (P = 0.05)	30	45

* Differences between controls and treatments were statistically significant.

Table 4.

*Pre-emergence Treatments in Plant Cane.**Comparison of Amiben liquid and granules with the standards (Karmex and Atrazine)*

<i>Location :</i> Reform H.H.7	<i>Variety :</i> B 49119
<i>Design :</i> 9 x 4 Randomised Blocks	<i>Planted :</i> 30/5/62
<i>Plot Size :</i> 1/40th Acre	<i>Applied :</i> 31/5/62
<i>Soil Type :</i> Sevilla clay	

Percent Weed Cover — Days after Application

Treatment Herbicide (active ingredient per acre)	Percent Weed Cover— Days after Application	
	72	97
Control — nil	73	85
2.4 lbs. Karmex + 0.6 lb. 2,4-D amine	25*	35*
2.5 lbs. Atrazine + 0.25 lb. Gramoxone	20*	30*
3 lbs. Amiben liquid	45*	75
4 lbs. Amiben liquid	28*	53*
5 lbs. Amiben liquid	43*	68
3 lbs. Amiben granules (10%)	35*	60
4 lbs. Amiben granules (10%)	33*	50
Control	73	85
L.S.D. (P = 0.05)	23	29

* Differences between controls and treatments were statistically significant.

*Comparison of Amiben liquid and granular
with standards (Karmex and Atrazine)*

In a trial on Sevilla clay, 4 lbs. active of Amiben granules or liquid proved to be as effective as the standards up to 97 days after an initial pre-emergence application (Table 4).

These results are of interest, considering the advantages of applying granular formulations. It might be practical in future to apply granular herbicides along with fertilizers immediately after planting.

*Comparison of Granular Formulations of
Atrazine and Simazine with Standards
(Karmex and Atrazine)*

Atrazine and simazine granules were compared with wettable powder formulations in a trial at Reform (Table 5). The granular formulations of atrazine and simazine were as effective as the

liquids and as effective as the standards. Weed control persisted for 93 days after a single pre-emergence treatment of either atrazine or simazine granular and wettable powder.

Table 5

*Pre-emergence Treatments in Plant Cane.**Comparison of Atrazine granules and Simazine granules with standards (Karmex and Atrazine)*

<i>Location :</i>	Reform H.H.7	<i>Variety :</i>	B.49119
<i>Design :</i>	7 x 4 Randomised Blocks	<i>Planted :</i>	30/5/62
<i>Plot Size :</i>	1/40th Acre	<i>Applied :</i>	4/6/62
<i>Soil Type :</i>	Sevilla clay		

Percent Weed Cover — Days after Application

Treatment Herbicide (active ingredient per acre)	Percent Weed Cover- Days after Application	
	68	93
Control — nil	65	85
2.4 lbs. Karmex + 0.6 lb. 2,4-D. amine	20*	30*
2.5 lbs. Atrazine + 0.25 lb. Gramoxone	10*	23*
2.5 lbs. Atrazine W.P. — sprayed	13*	38*
2.5 lbs. Atrazine (4% granules)	13*	25*
2.5 lbs. Simazine W.P. — sprayed	23*	30*
2.5 lbs. Simazine (4% granules)	30*	40*
L.S.D. (P = 0.05)	20	22

* Differences between controls and treatments were statistically significant.

Table 6.

*Pre-emergence Treatments in Plant Cane.
Comparison of Monsanto's CP 522 and Shell's WL 5792 with standards
(Karmex and Atrazine)*

<i>Location :</i>	Petit Morne 32	<i>Variety :</i>	B 5557
<i>Design :</i>	6 x 4 Randomised Blocks	<i>Planted :</i>	18/9/62
<i>Plot Size :</i>	1/40th Acre	<i>Applied :</i>	26/9/62
<i>Soil Type:</i>	Princes Town Marl		

Percent Weed Cover — Days after Application

Treatment Herbicide (active ingredient per acre)	Percent Weed Cover- Days after Application	
	20	35
Control — nil	28	35
2.4 lbs. Karmex + 0.6 lb. 2,4-D amine	3*	5*
5 lbs. Monsanto CP 522	5*	13*
8 lbs. Monsanto CP 522	5*	13*
2 lbs. Shell WL 5792 5 % granular	28	33
3 lbs. Shell WL 5792 5 % granular	13*	25
L.S.D. (P = 0.05)	14	14

* Differences between controls and treatments were statistically significant.

*Comparison of Monsanto's CP 522 and Shell's
WL 5792 with standards (Karmex and Atrazine)*

In a late season trial, CP 522 at 5 and 8 lbs. active per acre compared favourably with the standards (Table 6). However a 5% granular formulation of Shell's 5792 applied at 2 and 3 lbs. active per acre did not control weeds up to 35 days after application as well as the standards or as effectively as CP 522. The trial is continuing.

*Influence of Pre-Emergence Applications of
Karmex, Simazine, Atrazine, 2,4-D Amine.
Fenac, Kuron, Atratone, and Karmin on Yields*

Six trials were reaped during 1962 to determine the effect on yields of several pre-emergence herbicides. Results are summarized in Appendices 77 to 82. In none of the experiments were there any statistically significant differences in yields between control and treated plots. The results confirm similar data from Caroni Limited.

*Post-Emergence Weed Control in Ratoons.
Control of Rotboellia exaltata at La Gloria Estate*

A special weed problem developed in ratoons at La Gloria towards the end of February, 1962. Corngrass (*Rotboellia exaltata*) developed to 1 ft. to 3 ft. in height in several fields which had been reaped early in crop. An opportunity arose therefore to evaluate a number of post-emergence herbicides in such fields. The following mixtures were applied either in 30 to 40 gallons of water per acre over corn-grass ranging in height from 2 ft. to 4 ft., or in 20 gallons of water per acre where the weeds were less dense :

- (1) 2.4 lbs. active Karmex + 1 pint 2,4-D amine.
- (2) 2.4 lbs. active Karmex + 1 pint 2,4-D amine + 2 pints Albolineum.
- (3) 2.4 lbs. active Karmex + $\frac{1}{2}$ pint 2,4-D ester.
- (4) 2.4 lbs. active Karmex + $\frac{1}{2}$ pint 2,4-D ester + 2 pints Albolineum.

- (5) 2.4 lbs. active Karmex + 2 pints Albolineum.
- (6) 2.4 lbs. active Karmex + 0.1% Triton
- (7) 1.2 lbs. active Karmex + 1.25 lbs. active Atrazine.
- (8) 1.2 lbs. active Karmex + 1.25 lbs. active Atrazine + 2 pints Albolineum.
- (9) 2.5 lbs. active Atrazine + 0.50 lbs. Gramoxone.
- (10) 2.5 lbs. active Simazine + 0.50 lbs. Gramoxone.

Best results were noted in plots treated with 2.4 lbs. Karmex plus 2 pints Albolineum in 30 to 40 gallons of water per acre. The triazines in this instance were not as effective as mixtures containing Karmex. Several hundred acres of severely infested fields at La Gloria were subsequently cleared successfully with a mixture of 2.4 lbs. active Karmex + 2 pints Albolineum per acre.

*Post-Emergence Control of Panicum fasciculatum
and Echinochloa colonum*

Two other serious grass pests at Ste. Madeleine are bird-seed grass (*P. fasciculatum*) and wild rice (*Echinochloa colonum*). In a severely infested ratoon field at Reform it was possible to fully evaluate, against these grasses, the relative effectiveness of gramoxone, FS. 40, Karmex, Pesco 1815, Fenac, Kuron, Lorox, Amiben,

Dowpon, and Prometryne (Table 7). Best results were given by a mixture of Dowpon (4.25 lbs. active) plus 0.6 lbs. 2,4-D amine (Table 7). Lorox at 2 lbs. active performed well, and at higher rates of application the compound might well prove more effective.

Table 7.

*Post-emergence Treatments in Ratoon Cane.**Comparison of eight herbicides with standard (Karmex) and with F.S. 40*

<i>Location</i> :	Reform 46 (1)	<i>Variety</i> :	B 41227
<i>Design</i> :	12 x 3 Randomised Blocks	<i>Rotation</i> :	2nd Ratoons
<i>Plot Size</i> :	1/40th Acre	<i>Last Reaped</i> :	3/3/62
<i>Soil Type</i> :	Sevilla clay	<i>Applied</i> :	8/6/62

At the time of spraying the height of weeds and cane was approximately three feet. Predominant weeds were bird seed grass (*Panicum fasciculatum*) and wild rice grass (*Echinochloa colonum*).

Percent Weed Cover — Days after Application

Treatment Herbicide (active ingredient per acre)	Percent Weed Cover— Days after Application			
	5	13	29	58
Control — nil	87	97	100	97
0.5 lbs. Gramoxone	34*	44*	80	67
0.5 lbs. Gramoxone + 0.6 lbs. 2,4-D amine	37*	34*	54	50
40 gallons FS. 40 herbicide oil	30*	37*	67	70
2.4 lbs. Karmex + 0.6 lbs. 2,4-D amine	67	47	60	74
2.5 lbs. Pesco 1815	77	67	80	80
4 lbs. Fenac	77	74	90	50
5 lbs. Kuron	77	74	77	74
2 lbs. Lorox	57	34*	47*	47
5 lbs. Amiben	80	77	90	57
4.25 lbs. Dowpon + 0.6 lbs. 2,4-D amine	57	37*	34*	20*
2 lbs. Prometryne	54	40*	80	67
L.S.D. (P = 0.05)	48	53	49	63

* Differences between controls and treatments were statistically significant.

*Post-emergence Weed Control Trials
Conducted in Co-operation With Chemical
Manufacturers*

Two experiments were carried out in co-operation with Mr. A. Lacey of Plant Protection Limited (U.K.) and two trials were done co-operatively with Mr. G. Witt, local representative of Fisons (Overseas) Limited.

The Plant Protection Limited experiments were concerned with an evaluation of gramoxone as a post-emergence treatment in ratoons and in plants (Tables 8 and 9). Gramoxone at 0.5 and 1.0 lb. active per acre gave good initial control of weeds but its residual effect was negligible, unless either Karmex or Atrazine was included in the spray. One major disadvantage of gramox-

one is the damage to cane leaves resulting from the unavoidable contact of the sprays with the crop. The present Estate practice at Ste. Madeleine, which involves the use of "Karmine" in ratoons as a post-emergence treatment, has proved superior to sprays containing gramoxone. Ratoons appear to be tolerant to "Karmine," and weed control has been acceptable. Often a single post-emergence application of Karmine in ratoons is sufficient to destroy existing weeds and to prevent further germination of weeds until the cane "closes-in".

Table 8

*Pre-Emergence Weed Control in Ratoons.**Evaluation of Gramoxone with and without the residual herbicides Karmex and Atrazine*

<i>Location :</i>	Reform 46 (2)	<i>Variety :</i>	B 41227
<i>Design :</i>	13 x 4 Randomised Blocks	<i>Rotation :</i>	2nd Ratoons
<i>Plot Size :</i>	1/40th Acre	<i>Last Reaped :</i>	3/3/62
<i>Soil Type :</i>	Sevilla clay	<i>Applied :</i>	6/6/62

The predominant weeds were birdseed grass (*Panicum fasciculatum*) and wild rice grass (*Echinochloa colonum*). The cane was 3 to 4 feet high and the weeds only slightly less than this height, and of dense growth.

Percent Weed Cover — Days after Application

Treatment Herbicide (active ingredient per acre)	Days after Application Percent Weed Cover—	
	7	50
1 lb. Gramoxone	10*	23
0.5 lb. Gramoxone	18*	10*
1 lb. Gramoxone + 2.5 lbs. Karmex	13*	10*
0.5 lb. Gramoxone + 2.5 lbs. Karmex	18*	17
1 lb. Gramoxone + 1.5 lbs. Karmex	10*	20
0.5 lb. Gramoxone + 1.5 lb. Karmex	13*	15*
1 lb. Gramoxone + 2.5 lbs. Atrazine	10*	13*
0.5 lb. Gramoxone + 2.5 lbs. Atrazine	10*	25
1 lb. Gramoxone + 1.5 lb. Atrazine	10*	8*
0.5 lb. Gramoxone + 1.5 lb. Atrazine	15*	5*
2.4 lbs. Karmex + 0.6 lb. 2,4-D amine	33*	5*
2.5 lbs. Atrazine + 0.25 lbs. Gramoxone	23*	35
Control — nil	75	58
L.S.D. (P = 0.05)	11	43

* Differences between controls and treatments were statistically significant.

Table 9

*Post-Emergence Weed Control in Plants.
Gramoxone with and without the residual
herbicides Karmex, Simazine, and Atrazine*

<i>Location :</i>	Picton W. 5/6	<i>Variety :</i>	B 49119
<i>Design :</i>	21 x 3 Randomised Blocks	<i>Planted :</i>	11/7/61
<i>Plot Size :</i>	1/40th Acre	<i>Applied :</i>	Treatments 15 — 20
<i>Soil Type :</i>	Debe Heavy Clay		16/7/62
			1 — 14
			26/9/62

The treatments containing Karmex, Atrazine and Simazine were applied soon after planting and pre-emergence to weeds. Two months later the post-emergence treatments were applied. At the first date of scoring (50 days after) only the pre-emergence plots had been counted and the remainder of the plots were equivalent of additional "Controls". At the second date of scoring (96/29 days after) the plots had received pre-emergence sprays at 96 days, and post-emergence sprays at 29 days prior to scoring.

Percent Weed Cover — Days after Application

Treatment Herbicide (active ingredient per acre)	Percent Weed Cover— Days after Application	
	50	96/29
1 lb. Gramoxone	60	20*
0.5 lb. Gramoxone	57	33*
1 lb. Gramoxone + 4 lbs. Karmex	50	13*
0.5 lb. Gramoxone + 4 lbs. Karmex	50	13*
1 lb. Gramoxone + 2 lbs. Karmex	43	10*
0.5 lb. Gramoxone + 2 lbs. Karmex	33	10*
1 lb. Gramoxone + 4 lbs. Atrazine	40	10*
0.5 lb. Gramoxone + 4 lbs. Atrazine	40	10*
1 lb. Gramoxone + 2 lbs. Atrazine	33	27*
0.5 lb. Gramoxone + 2 lbs. Atrazine	43	23*
1 lb. Gramoxone + 4 lbs. Simazine	47	13*
0.5 lb. Gramoxone + 4 lbs. Simazine	40	13*
1 lb. Gramoxone + 2 lbs. Simazine	57	20*
0.5 lb. Gramoxone + 2 lbs. Simazine	43	23*
4 lbs. Karmex	7*	17*
2 lbs. Karmex	3*	30*
4 lbs. Atrazine	13*	43
2 lbs. Atrazine	23	60
4 lbs. Simazine	40	43
2 lbs. Simazine	23	67
Control — nil	50	80
L.S.D. (P = 0.05)	33	39

* Differences between controls and treatments were statistically significant.

Two trials with Prometone and Atratone were applied by logarithmic sprayer in co-operation with Fisons Limited. The compounds were applied at dosages from 10 lbs. per acre to zero on four varieties: B 4362, B 41227, B 49119, and B 50112. Four weeks after spraying soil samples were collected for analyses by the Fisons laboratory to determine rates of break-down for the two herbicides. To date, the trial has not revealed major differences in weed control. Previous field trials had shown that Prometone and Atratone were generally ineffective under Trinidad conditions. The two trials reported here have confirmed the preliminary observations.

Control of Weeds in Field Borders

Two major weed pests in borders of cane fields at Ste. Madeleine are bamboo grass (*Paspalum fasciculatum*) and para grass (*Panicum purpurascens*). In recent years para grass has spread rapidly and there is some danger that it might enter cane fields, where at present it is not a serious problem. The two species, bamboo and para grass, comprise over 90% of the total weed composition in field borders.

FS.40 had been used by the Estates for a few years to control weeds on edges of fields, but the residual effectiveness of a single spray was less than desired; generally about 30 days. Also those weeds which were more resistant to the oil spray were "selected," and we now find that para grass and bamboo grass predominate. Therefore, a great deal of effort has been placed into finding a substitute for FS.40, preferably a compound with greater residual activity. At least 24 different types of treatments have been evaluated. These are enumerated below; dosages are given in lbs. or pints product per acre:

1. 3 lbs Karmex + 1 pint Amine 2,4-D + 1 pint Albolineum in 30 gallons water per acre.
2. 3 lbs. Karmex + 1 pint Amine 2,4-D + 1 pint Albolineum in 60 gallons water per acre.
3. 6 lbs. Karmex + 2 pints Amine 2,4-D + 2 pints Albolineum in 30 gallons water per acre.
4. 6 lbs. Karmex + 2 pints Amine 2,4-D + 2 pints Albolineum in 60 gallons water per acre.
5. 3 lbs. Karmex + 5 lbs. Atrazine + 1 pint Amine 2,4-D + 1 pint Albolineum in 30 gallons water per acre.
6. 3 lbs. Karmex + 5 lbs. Atrazine + 1 pint Amine 2,4-D + 1 pint Albolineum in 60 gallons water per acre.
7. 3 lbs. Karmex + 50 lbs. Chlorate in 60 gallons water per acre.
8. 5 lbs. Atrazine + 50 lbs. Chlorate in 60 gallons water per acre.
9. 3 lbs. Karmex in 30 gallons water per acre.
10. 6 lbs. Karmex in 30 gallons water per acre.
11. 3 lbs. Dowpon in 30 gallons water per acre.
12. 6 lbs. Dowpon in 30 gallons water per acre.
13. 6 lbs. Dowpon + 2 pints Albolineum in 30 gallons water per acre.
14. 6 lbs. Dowpon + 3 lbs. Karmex in 30 gallons water per acre.
15. 10 lbs. Trichloroacetate (Varitox) in 30 gallons water per acre.
16. 10 lbs. Trichloroacetate (Varitox) + 6 lbs. Dowpon in 30 gallons water per acre.
17. 10 lbs. Trichloroacetate (Varitox) + 3 lbs. Karmex in 30 gallons water per acre.
18. 5 lbs. Trichloroacetate (Varitox) + 3 lbs. Dowpon in 30 gallons water per acre.
19. 1 lb. Gramoxone in 30 gallons water per acre.
20. 3 lbs. Karmex + ½ lb. Gramoxone in 30 gallons water per acre.
21. 3 lbs. Karmex + 1 lb. Gramoxone in 30 gallons water per acre.
22. 6 lbs. Dowpon + 1 lb. Gramoxone in 30 gallons water per acre.
23. 3 lbs. Karmex + 3 lbs. Dowpon.
24. 3 lbs. Karmex + 3 lbs. Dowpon + ½ lb. Gramoxone.

Table 10.
Control of Weeds in Field Borders.
Comparison of Dowpon with Karmex/Amine/
Albolineum

Location : Trace of Cedar Hill PM 11/PM 20
Design : 5 x 4 Randomised Blocks
Plot Size : 1/40th Acre
Soil Type : Princes Town Marl
Applied : 4/11/61.

The trial was carried out on both sides of a trace where there was dense weed growth consisting of approximately 75% para grass and, most of the remainder, bamboo grass. All herbicides were applied in 30 gallons of water.

Treatment Herbicide (active ingredient per acre)	Percent Weed Cover- Days after Application	
	8	73
Control — nil	100	100
3 lbs. Karmex + 0.6 lbs. 2,4-D amine + 2 pints Albolineum.	37*	42*
3 lbs. Dowpon	52*	32*
6 lbs. Dowpon	45*	5*
6 lbs. Dowpon + 2 pints Albolineum	42*	3*
L.S.D. (P = 0.05)	17	35

* Differences between controls and treatments were statistically significant. While all treatments were significantly different from the control at both scoring dates, the outstanding treatment was 6 lbs. Dowpon per acre. Plots treated with Dowpon, either with or without Albolineum, maintained not more than 5% cover of weeds at 10 weeks after application.

The results of ten trials may be summarized as follows :

(1) Para grass was best controlled with 6 lbs. Dowpon applied in 30 gallons of water per acre.

(2) Bamboo grass was best controlled with 3 lbs. of the 80% formulation of Karmex.

Results from a typical experiment are given in Table 10. Following successful trials with Dowpon, about 6,000 lbs. of the compound were used

at Ste. Madeleine during 1962 for the control of para grass. Karmex was used successfully for the control of bamboo grass in areas where this species was prevalent.

The new herbicide Hyvar has been compared with Dowpon in late season trials. At three months after application to para grass along field edges, 5 lbs. Hyvar has proved superior to 5 lbs. Dowpon. Further trials are in progress to compare the new compound, on a cost-performance basis, with Dowpon and Karmex.

Recommendations for Chemical Weed Control at Ste. Madeleine

A. For pre-emergence weed control in plants

1. In areas where both banks are broken at planting: "Karmine" (2.4 lbs. active Karmex plus 0.63 lbs. active 2,4-D amine).

2. In areas where single banks are broken at planting apply "Karmine" after breaking first bank, followed by "Atrazine" (2.5 lbs. active) + 0.63 lb. active 2,4-D amine at breaking of second banks. In varieties which show tolerance to diuron, "Karmine" may be employed at breaking of second banks.

3. Large scale extension trials comparing Pesco 1815 (4 lbs. active per acre), Kuron (4 lbs. active per acre), Lorox (2 and 3 lbs. active per acre), and Fenac 3 and 4 lbs. active per acre with the standards ("Karmine" and atrazine-2,4-D mixtures) are warranted from experimental results with these materials at Ste. Madeleine and at Caroni Limited. Pesco 1815 should be evaluated on a field-scale as a follow-up treatment when second banks are broken.

B. For Post-Emergence Control of Para Grass and Bamboo Grass along Field Borders

1. For control of *Para Grass* : 5 lbs. Dowpon in 30 to 40 gallons of water per acre.

2. For control of *Bamboo Grass* : "Karmine" or 2.4 lbs. active Karmex in 30 to 40 gallons of water per acre.

3. Large-scale extension comparisons of Hyvar (3 to 5 lbs. active per acre), Dowpon, and Karmex for control of both para and bamboo grass.

C. Pre- and Post-Emergence Control of Weeds in Ratoons

1. "Karmine" in 30 to 40 gallons of water per acre where weeds have emerged, or "Karmine" in 20 gallons of water per acre where weeds have not germinated.

E. Crop Quality

1. At Caroni Limited

I. D. LAWRIE

One of the most important problems facing the sugar grower in Trinidad, and elsewhere, is the relatively high cost of reaping canes of low sucrose content. The problem is particularly severe under Trinidad conditions during the beginning of crop (i.e. late December and early January) and extending into the middle of February. Average TC/TS ratios range from 14.0 to 13.0 during the first few weeks of crops but progressively improve to about an average TC/TS ratios of 9.0 by mid-March.

A number of experiments were completed during the period November 1961 to April 1962, in which several compounds were evaluated as pre-harvest treatments, both in small and large-scale trials, in an effort to improve the juice quality of sugar cane prior to reaping.

The following compounds were evaluated:

1. Pesco 1815—2,3,6-Trichlorobenzoic acid + 2 methyl-4-chlorophenoxyacetic acid
2. Reglone —1:1'-ethylene-2:2'-dipyridylum dibromide
3. Kuron —(2, -(2,4,5 Trichloro-phenoxy) propionic acid,

propylene glycol, butyl ether ester

4. EPS 176/1—2,3,6-Trichlorobenzoic acid

5. Six Esso Sucrol formulations

Small Scale Trials:

Pesco 1815, Kuron, Reglone and EPS 176/1 were evaluated in small-scale, replicated trials of 1/40 acre plots. The treatments were applied in 40 gallons of water per acre by means of knapsack sprayers connected to an overhead boom fitted with six Tee-jet 15006 nozzles. A wetting agent was incorporated in all treatments, at 0.1% vol. of spray.

Juice analyses were carried out on two-stool samples taken at random from each plot at predetermined intervals after the treatments were applied. Results are discussed below:

1. Pesco 1815:

Pesco 1815 was evaluated in two separate trials; the first at rates of 4, 8 and 12 lbs./acre, and the second at 1, 2 and 4 lbs./acre. Data from these experiments are presented in Tables 1 and 2.

Table 1.

Influence of Pesco 1815 on Juice Quality of Ten Month-Old 3rd Ratoons of B 41227

No. of Days after Application	Control	Pesco 1815			Sig.	Diff.
		4 lbs./acre	8 lbs./acre	12 lbs./acre	1%	5%
TC/TS Ratio						
Initial	12.70	11.99	12.00	12.37	—	—
1	12.13	12.40	12.30	11.85	—	—
4	12.12	12.24	12.25	12.86	—	—
8	11.23	11.38	11.66	11.70	—	—
12	11.10	10.61	11.83	11.25	—	—
18	11.28	10.71	11.88	10.27	—	—
25	11.09	9.62	10.43	10.20	—	—
32	9.93	9.69	10.60	10.35	—	—
38	10.10	9.71	11.09	10.24	—	—

Table 2.
Influence of Pesco 1815 on Juice Quality of Eight
Month-Old 1st Ratoons of B 41227

No. of Days after Application	Control	Pesco 1815			Sig.	Diff.
		1 lb./acre	2 lbs./acre	4 lbs./acre	1%	5%
TC/TS Ratio						
Initial	12.90	12.54	12.49	12.05	—	—
4	11.99	11.46	11.40	11.50	—	—
7	11.69	11.30	11.29	11.41	—	—
11	10.99	11.04	10.71	10.52	—	—
15	10.56	10.65	10.82	10.46	—	—
20	10.16	9.59	9.85	9.68	—	—
28	9.81	9.53	9.77	9.70	—	—

There were no statistically significant differences between treatments and controls. However, it is interesting to note that improvement in juice quality was most marked in canes which had been sprayed with 4 lbs./acre of Pesco 1815, and harvested 25 days after treatment application (Table 1). A similar result was

obtained at lower concentrations per acre, when harvested 20 days after treatment application (Table 2).

2. Reglone:

Reglone was evaluated at 0.5, 1 and 2 lbs./acre. The results are presented in Table 3.

Table 3.
Influence of Reglone on Juice Quality of Eight
Month-Old 2nd Ratoons of B41227

No. of Days after Application	Control	Reglone			Sig.	Diff.
		0.5 lb./acre	1.0 lb./acre	2.0 lb./acre	1 %	5 %
TC/TS Ratio						
Initial	14.64	16.13	14.01	16.20	—	—
2	15.03	14.62	14.66	15.91	—	—
7	12.78	17.62	14.07	14.89	—	—
13	13.15	15.63	15.23	15.35	—	—

The three rates at which Reglone was applied caused severe desiccation of foliage within one week. There were no statistically significant differences between the treatments and control.

3. Kuron:

Kuron was evaluated at 4, 6, and 8 lbs./acre in two trials, the results of which are presented in Table 4.

Table 4.

*Influence of Kuron on Juice Quality of Eight and Ten Month
Old 3rd and 1st Ratoons of B 41227*

Treatments	TRIAL I									TRIAL II					
	10 month-old 3rd ratoons									8 month-old 1st ratoons					
	No. of days after application									No. of days after application					
	Initial	3	6	10	14	20	27	34	40	Initial	4	11	15	20	26
	TC/TS Ratio									TC/TS Ratio					
Control	12.70	12.13	12.12	11.23	11.10	11.28	11.09	9.93	10.10	36.14	30.93	23.46	18.80	17.03	18.02
Kuron 4 lbs./acre	13.13	12.83	12.02	11.36	11.69	11.69	10.58	10.22	10.60	37.15	25.55	25.24	20.66	19.78	15.98
Kuron 6 lbs./acre	12.50	12.62	12.20	11.54	11.68	11.63	10.07	10.77	9.76	34.62	36.06	26.85	19.72	17.40	16.95
Kuron 8 lbs./acre	12.69	12.08	12.46	12.33	11.43	11.38	10.72	10.21	10.50	38.87	32.90	24.81	21.65	18.94	16.67
L.S.D. 5%	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

There were no statistically significant differences between treatments with Kuron and controls. However in Trial II (Table 4), the 4 and 8 lbs./acre rates of Kuron improved the juice quality from an initial TC/TS ratio of 37.15 to 15.98, and 38.87 to 16.67, respectively, after 26 days, while the control showed a TC/TS

ratio of 36.14 initially, and 18.02 after 26 days.

4. *EPS 176/1 (2,3,6-Trichlorobenzoic acid)*

EPS 176/1 was evaluated at 4, 8 and 12 lbs./acre in two trials. Also incorporated in Trial I was a treatment of 0.1% Tergitol 7.

The results of these trials are presented in Table 5.

Table 5.
Influence of EPS 176/1 (2,3,6-Trichlorobenzoic acid) on Juice
Quality of Nine Month Old 1st and 2nd Ratoons of B 41227

Treatments	TRIAL I								TRIAL II						
	1st Ratoons								2nd Ratoons						
	No. of days after application								No. of days after application						
	Initial	5	8	15	20	27	33	Initial	6	10	14	19	26	32	
	TC/TS Ratio								TC/TS Ratio						
Control	27.63	23.83	22.77	19.50	18.54	16.91	16.05	25.43	20.51	21.02	17.54	18.82	13.66	13.15	
EPS 176/1 4 lbs/acre	26.21	31.69	22.15	19.33	17.72	15.55	16.45	25.40	20.56	18.89	16.99	14.78	14.17	12.84	
EPS 176/1 8 lbs/acre	26.75	23.16	20.45	21.82	15.94	17.54	15.58	21.75	20.44	19.60	15.32	13.27	14.12	10.25	
EPS 176/1 12 lbs/acre	27.40	29.26	23.38	20.19	16.60	17.92	14.77	21.38	18.08	20.34	16.51	15.47	13.35	11.69	
Tergitol 7 at .1% vol.	23.23	24.40	20.81	18.52	17.23	16.36	14.60	—	—	—	—	—	—	—	
L.S.D. @ 5%	—	—	—	—	—	—	—	—	—	—	—	—	—	2.01	

Improvements in TC/TS ratios were more marked in canes which had been treated with 8 and 12 lbs./acre EPS 176/1 than in controls, in both of the trials. The difference between the 8 lbs./acre rate of EPS 176/1 and the control was significant, 32 days after application.

5. *Esso EAP oil formulations (Sucrol)*

A number of different formulations of Sucrol are now available. Several have been

prepared in aerosol containers. Six of the oil formulations were evaluated in a small scale replicated trial of 1/200 acre plots. Treatments were applied by means of "aerosol type bombs," spraying onto the foliage of the sugar cane.

The results of the preliminary screening are summarised in Table 6.

Table 6.

Influence of six different formulations of Sucrol on juice quality of 9 month-old 3rd ratoons (B 41227). Preliminary screening.

No. of Days After Application	Control	Esso EAP Oil Formulations					
		1	3	120	121	122	123
Tons Cane per Ton Sugar							
Initial	10.91	11.19	11.15	11.77	11.63	11.28	10.97
2	10.39	10.23	12.12	12.31	10.13	11.59	9.89
5	10.75	10.92	11.12	11.64	10.00	10.29	10.54
12	9.77	10.54	9.77	9.47	9.93	10.21	9.89
15	9.48	9.95	9.39	9.24	8.93	8.93	9.48
20	9.26	8.91	9.22	9.57	9.06	9.54	9.19
27	9.33	8.97	9.19	9.28	9.37	8.83	8.62

The TC/TS ratio in controls improved, over a 20 day period, from 10.91 to 9.26 (or 1.65), while formulation No. 1, over the same period of time, gave an overall improvement of—2.28 (i.e. TC/TS 11.19 initial to TC/TS 8.91) after 20 days. There were, however, no statistically significant differences.

Large Scale Trials:

Preliminary results of small scale trials had indicated that the sucrose content of sugar cane might be altered by applications of different formulations of the Esso experimental oil (Sucrol) and Pesco 1815. More extensive field trials have confirmed these earlier observations.

1. *Esso Experimental Oil (Sucrol) EAP 1.*

A new formulation of the Esso Oil (Sucrol) was evaluated as an aerial application of 1½ U.S. gall./acre on approximately 40 acres, consisting of four fields of 9 month old plant canes of B 41227. Each field was divided in half, one

half of which was sprayed by means of a helicopter, while the other half served as a control.

Samples were taken in each field one day prior to the application of Sucrol (EAP 1.). The samples were taken from both the area to be treated and the control area. Subsequent samples were taken at 7, 14, 21, 26, and 33 days after treatment. Laboratory samples as well as factory samples were taken. The factory samples consisted of 5 to 9 individual samples, each sample comprising 7 to 9 tons of cane, taken simultaneously from the control and from the sprayed area.

Unfortunately, a wildcat strike at B.C. Factory interrupted the factory sampling. In addition the trial was plagued with other difficulties, (i.e., contamination of reaped canes with tops and trash, etc.). In any event, those results which were salvaged, are outlined in Table 7.

Table 7.

*Influence of Aerial Application of Sucrol 1½ U.S. gallons
per acre) on Juice Quality of 9 month-old plant cane (B 41227)
Felicite*

Days after treatment	Laboratory Analyses				Factory Analyses			
	Control	Treated	L.S.D.		Control	Treated	L.S.D.	
	TC/TS		1%	5%	TC/TS		1%	5%
Initial	14.33	14.33	—	—	—	—	—	—
7	14.17	14.14	—	—	20.52	22.31	—	—
14	13.62	14.21	—	—	—	—	—	—
21	13.17	11.88	—	—	—	—	—	—
26	11.32	11.17	—	—	13.93	13.83	—	—
33	10.27	10.48	—	—	13.05	12.23	—	—

There were no statistically significant differences between controls and treatments at any of the dates of harvest. The large discrepancy between the laboratory analyses and the factory analyses, at 7 days after treatment, was due entirely to the overabundance of tops and trash

accompanying the reaped canes to the factory. At 21 days after treatment there appeared to be an improvement in rendement of juice from treated canes, but it was not possible to confirm this on bulk samples at the factory mill, owing to the wildcat strike.

2. *Pesco 1815:*

Pesco 1815—a mixture of trichlorobenzoic acid and 2-methyl-4-chlorophenoxyacetic acid was applied at a rate of 4 lbs./acre by helicopter to approximately 40 acres, consisting of three

fields of 9 month-old plant canes of variety B 41227. The method of application and sampling is similar to that described for Sucrol (EAP 1.).

The results are summarised in Table 8.

Table 8.
Influence of 4 lbs./acre of Pesco 1815 on juice quality of 9 month old plant cane of variety B 41227

No. of Days after Treatment	Laboratory Sample				Factory Sample			
	Control	Treated	L.S.D.		Control	Treated	L.S.D.	
	TC/TS		1%	5%	TC/TS		1%	5%
Initial	10.76	9.87	—	—	—	—	—	—
9	10.33	10.53	—	—	—	—	—	—
14	10.45	10.25	—	—	10.43	10.59	—	—
20	9.72	9.72	—	—	9.63	9.72	—	—
28	9.44	9.22	—	—	9.45	8.94	0.22	0.16

Highly significant (0.01 level) differences in juice quality were recorded between controls and treated canes at 28 days after treatment.

The TC/TS ratios improved both in controls and in treated canes, from 14 to 28 days after treatment. In controls the overall improvement, as shown by the factory samples, amounted to 0.98 as compared to 1.65 in treatments.

These factory results confirm the trends of small scale trials with Pesco 1815 and EPS

176/1.

Since the active ingredient of EPS 176/1 is TBA and the active ingredient of Pesco 1815 is a mixture of TBA and MCPA, it would seem reasonable to assume the improvement is a direct result of the application of TBA. It is hoped, however, to confirm this assumption by applying, separately, both TBA and MCPA to selected fields in the coming year.

E. Crop Quality (Continued)

2. At Ste. Madeleine

F.B. Little
E.M. Johnson

A number of compounds were also evaluated for their effect on juice quality of canes grown at Ste. Madeleine. Unfortunately all of the experiments were in small-scale plot tests, which are generally characterized by a large variation and between plots with respect to TC/TS ratios, especially early in crop. The results of the experiments are nevertheless presented in

Tables 1 to 4. None of the experimental compounds proved effective as cane ripeners.

During 1963 it is planned that the compounds which were effective in the Caroni Limited experiments will be evaluated at Ste. Madeleine, employing experimental designs which may eliminate excessive variability.

Table 1.

Crop Quality — Kuron

<i>Location:</i> Reform 4 <i>Design:</i> 4 x 4 Latin Square <i>Plot Size:</i> 1/40th acre <i>Soil Type:</i> Sevilla Clay <i>Variety:</i> B 49119	<i>Last Reaped:</i> Plants — 1/3/61 <i>Applied:</i> 21/12/61
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Treatments were applied in 40 gallons of water per acre.
Results are the average from 8 stool samples.

Treatments lbs. active per acre	Pre- Treatment	Days after treatment			
		6	15	20	27
TC/TS					
Control	18.50	16.60	15.70	15.29	12.76
Kuron 4 lbs/acre	18.78	17.06	17.54	17.98	14.45
Kuron 6 lbs/acre	18.73	18.51	17.77	15.80	12.93
Kuron 8 lbs/acre	17.47	17.36	16.41	15.47	14.60
LS.D. P = 0.05	4.34	5.42	3.29	3.41	3.46

Table 2.

Quality Control — Reglone

Location:	Reform 43	Last Reaped:	Plants — 11/5/61
Design:	4 x 4 Latin Square	Applied:	29/12/61
Plot Size:	1/40 acre		
Soil Type:	Sevilla Clay		
Variety:	B 41227		

Treatments were applied in 40 gallons of water per acre.
Results are the average from 8 stool samples.

Treatments lbs. active per acre	Pre- Treatment	Days after treatment			
		5	14	20	26
TC/TS					
Control	20.71	22.09	20.98	18.98	18.66
Reglone 0.5 lb./acre	19.73	22.57	21.74	19.91	19.19
Reglone 1.0 lb./acre	20.97	23.21	22.69	20.92	19.25
Reglone 2.0 lb./acre	20.03	23.45	22.94	18.67	22.51
L.S.D. P = 0.05	6.98	5.14	6.39	5.02	5.25

Table 3.

Quality Control — Thimet

Location:	Reform 43	Last Reaped:	Plants — 11/5/61
Design:	4 x 4 Latin Square	Applied:	13/1/62
Plot Size:	1/40 acre		
Soil Type:	Sevilla Clay		
Variety:	B 41227		

Thimet was applied as granules (10%) using a
Cook "granular" duster, aiming the granules
over and into the leaf area.
Results are the average from 8 stool samples.

Treatments lbs. active per acre	Pre- Treatment	Days after treatment		
		4	12	19
TC/TS				
Control	16.59	13.92	16.10	11.48
Thimet 1 lb./acre	17.90	16.31	17.68	12.30
Thimet 2 lb./acre	18.18	14.30	16.61	11.72
Thimet 3 lb./acre	18.25	14.56	17.33	11.82
L.S.D. P = 0.05	3.95	3.19	5.05	1.02

Table 4.

Quality Control — EPS 176/1

Location: Reform 4
 Design: 4 x 4 Latin Square
 Plot Size: 1/40 acre
 Soil Type: Sevilla Clay
 Variety: B 49119

Last Reaped: Plants — 1/3/61.
 Applied: 21/12/61

Treatments applied in 40 gallons of water per acre. Results are the average from 8 stool samples.

Treatments lbs. active per acre	Pre- Treatment	Days after treatment			
		7	15	20	27
TC/TS					
Control	23.80	23.20	18.04	18.90	14.57
EPS 176/1 4 lbs./acre	20.37	19.54	17.44	18.32	16.34
EPS 176/1 8 lbs./acre	21.86	21.09	19.17	19.50	15.48
Tergitol 7 0.1 %	20.56	21.32	18.52	19.28	13.85
L.S.D. P = 0.05	6.85	7.61	3.95	4.48	3.39

II. PLANT PHYSIOLOGY

A. Naturally-Occurring Plant Growth

Substances in Sugar Cane

A. J. Vlitos
H. G. Cutler
B. H. Most

1. Introduction

During the past three years the long-range programme of physiological research has been concerned with the characterization of the naturally-occurring plant growth substances in the sugar cane. It was determined during 1961 and 1962 that the major auxin in sugarcane roots, shoots, and true seed is an ether-soluble acid with properties resembling those of indole-3-acetic acid. A number of other growth substances were also isolated from roots and shoots at different stages in development. More recently a programme was initiated to attempt the isolation and identification of the naturally-occurring gibberellins or "gibberellin-like" compounds in sugarcane.

Gibberellins are now well recognized as physiologically important natural constituents of plants. In general these substances act to promote the growth of intact plants grown in light, and in some cases appear to influence flowering. Nine different types of gibberellins are known at present, but it is quite likely that in future others may be isolated. Sugarcane, which is characterized by a relatively rapid growth rate, quite likely contains one or another of the known gibberellins, but to date there are no published accounts of gibberellins having been isolated from cane, nor are there any published accounts of efforts to do so. In view of the possible relationship between vegetative growth (particularly in canes nearing maturity) and sucrose content of stalks at harvest, it was feasible to initiate a long-range programme of research designed to investigate the role of naturally-occurring gibberellins in the growth process as it relates to sucrose metabolism.

2. Some Preliminary Results

a. The Bioassay

The choice of the bioassay with which to detect sugarcane gibberellins becomes a critical factor when one considers that there are nine gibberellins, each with slightly different physiological properties. Intact plants, rather than excised parts of plants, are generally better suited for the detection of gibberellin-like substances. However, the intact plant must be provided with small quantities of the gibberellin either daily, or at frequent intervals, to obtain the maximum growth response. Segments of plants, on the other hand, may be grown in solutions containing the gibberellin and more of the segments may be handled in a smaller space. However, segments also respond to the classical "auxins" and it becomes difficult therefore to differentiate in such an assay between gibberellin-like substances and auxins.

In a preliminary experiment coleoptile sections were prepared from etiolated oat seedlings which had been grown in a dark-room for four days. Sections, four millimeters long, were prepared. In the initial experiments the first true leaf was not removed from the coleoptile, but in subsequent tests the first true leaf only was employed as the bioassay material.

The results of the initial experiment, in which indole-3-acetic acid and the K salt of gibberellic acid were evaluated in the coleoptile straight growth assay, are presented in Table 1.

Table 1.

The Effect of the K salt of GA and IAA on elongation of oat coleoptiles containing first true leaves

Treatment	ppm.	Final Mean Growth in mm.(x3) of the Coleoptile Sheath	Mean Final Growth in mm. (x3) of the First True Leaf
K salt of Gibberellic acid	0	16.7 (Control)	16.1
K salt of Gibberellic acid	0.00001	16.4	16.0
K salt of Gibberellic acid	0.0001	16.4	16.6
K salt of Gibberellic acid	0.001	17.1	15.6
K salt of Gibberellic acid	0.01	17.7	17.7
K salt of Gibberellic acid	0.1	18.0	18.2
K salt of Gibberellic acid	1.0	18.3	16.6
	Molarity	Final Mean Growth in mm. (x3) of the Coleoptile Sheath	
Indole-3-Acetic Acid	0	16.5	17.0
Indole-3-Acetic Acid	10 ⁻¹⁰	16.2	17.4
Indole-3-Acetic Acid	10 ⁻⁹	16.9	16.6
Indole-3-Acetic Acid	10 ⁻⁸	17.0	16.8
Indole-3-Acetic Acid	10 ⁻⁷	19.2	16.6
Indole-3-Acetic Acid	10 ⁻⁶	23.8	15.0
Indole-3-Acetic Acid	10 ⁻⁵	28.7	—

Indole-3-acetic acid proved more active, in this particular assay, than the K salt of gibberellic acid. In a second experiment we evaluated the

responses of the first true leaf to various concentrations of GA and IAA (Table 2).

Table 2.

Treatment	Concentrations ppm.	Final Mean Growth of First True Leaf in mm. (x3)
K salt of Gibberellic Acid	0	16.4 (Controls)
K salt of Gibberellic Acid	0.00001	17.1
K salt of Gibberellic Acid	0.0001	16.7
K salt of Gibberellic Acid	0.001	16.1
K salt of Gibberellic Acid	0.01	15.9
K salt of Gibberellic Acid	0.1	16.2
K salt of Gibberellic Acid	1.0	17.8
	Molarity	Final Mean Growth of First True Leaf in mm. (x3)
Indole-3-Acetic Acid	0	16.3 (Controls)
Indole-3-Acetic Acid	10^{-10}	16.2
Indole-3-Acetic Acid	10^{-9}	16.8
Indole-3-Acetic Acid	10^{-8}	15.6
Indole-3-Acetic Acid	10^{-7}	16.3
Indole-3-Acetic Acid	10^{-6}	16.5
Indole-3-Acetic Acid	10^{-5}	16.6

Although the first true leaf was slightly more responsive to GA than to IAA, especially at lower concentrations, the differences were not sufficiently marked to differentiate between the two types of growth regulants. Consequently, the rice seedling assay of Murakami* was evaluated. Two micrograms of the K salt of gibberellic acid was chromatographed on Whatman No. 1 filter paper in a solvent consisting of isopropanol-ammonia-water (10:1:1). The developed chromatograms were cut into 10 equal portions, along

the chromatographic path, were eluted, and 2 mls. of eluates in buffer-sucrose solution were added to test tubes in which were also placed five 3-day old rice seedlings. Results are presented in Table 3.

* Murakami, Yukata. Paper Chromatographic studies on change in gibberellins during seed development and germination in *Pharbitis Nil.* Bot. Mag. (Tokyo) 74: 241-247, 1961.

Table 3.

Elongation of 3 Day-Old Rice Seedlings Exposed for 7 Days to Eluates from Paper Chromatograms Containing 2 Micrograms of Gibberellic Acid

Rf	Height in cm. (from seed attachment to "collar" of first true leaf)
0—0.1	5.5
0.1—0.2	6.0
0.2—0.3	5.2
0.3—0.4	5.4
0.4—0.5	5.1
0.5—0.6	5.3
0.6—0.7	10.7*
0.7—0.8	7.0*
0.8—0.9	5.1
0.9—1.0	5.3
Controls (Buffer-Sucrose)	5.1

* Differences were statistically significant at .01 level.

Eluates of the chromatograms from Rf 0.6—0.7 and 0.7—0.8 promoted the elongation of the first true leaf of rice seedlings. The results indicated a) that authentic samples of GA had an Rf value coincident with that of the areas of the chromatograms which yielded active

eluates, and b) that the rice seedling assay might be employed satisfactorily to detect naturally-occurring gibberellic acid.

Subsequently the rice seedling assay was employed in detecting gibberellins isolated from shoots and roots of cane, as discussed below.

b. Gibberellins in Sugarcane

The extraction procedure in the initial experiments was as follows:

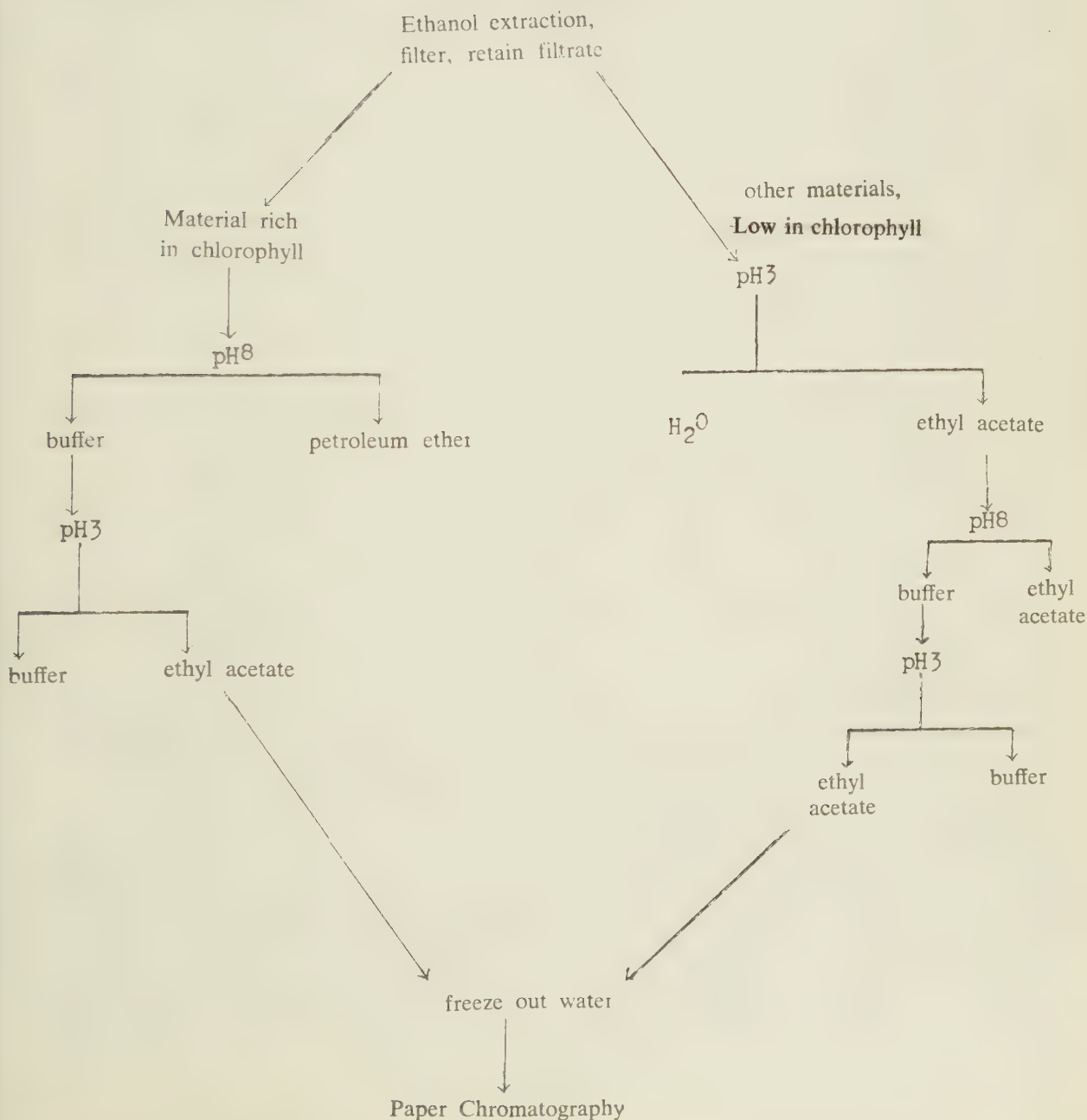
a) Plant material was harvested and frozen rapidly with dry ice in the field.

b) The frozen material was stored in a

deep-freeze until extracted.

c) Ethanol was poured over the frozen tissues and the mixture of tissues plus ethanol was placed in a Waring blender and macerated.

The flow sheet, after maceration of the tissue, was as follows:



The final extracts were chromatographed in a solvent of isopropanol-ammonia-water (10:1:1) on Whatman No. 3 filter paper. After the chromatograms were developed they were cut into ten equal parts, and placed into test tubes.

Two milliliters of distilled water and five *Joya* rice seedlings (3-day old) were then placed in each of the test tubes containing the appropriate paper chromatographic strip. Results are presented in Tables 4 and 5.

Table 4.

*Elongation of Three Day Old Rice Seedlings Exposed for Seven Days to Eluates of Paper Chromatograms Containing Extracts of Sugar Cane Shoots and Roots**

Rf	Height in cm. (from seed attachment to "collar" of first true leaf)	
	Eluates from Chromatograms of Sugarcane Extracts of 56 Days Old Shoots	Eluates from Chromatograms of Sugarcane Extracts of 96 Days Old Roots
0.0—0.1	3.8**	6.1
0.1—0.2	3.2**	6.2
0.2—0.3	5.4	6.2
0.3—0.4	5.7	6.5
0.4—0.5	5.8	5.5
0.5—0.6	6.3	5.9
0.6—0.7	5.7	5.9
0.7—0.8	6.1	5.8
0.9—1.0	5.4	5.9
Controls (distilled water)	5.8	5.0
K Salt of GA 2 micrograms		8.82

* 495 mgs. dry wt. of shoots and 600 mgs. dry wt. roots represented on chromatograms.

** Inhibition was statistically significant at 0.1 level.

Table 5.

*Elongation of Three Day Old Rice Seedlings Exposed for Seven Days to Eluates of Paper Chromatograms Containing Extracts of Sugarcane Shoots and Roots **

Rf	Height in cm. (from seed attachment to "collar" of first true leaf)	
	Eluates from Chromatograms of Sugarcane Extracts of 56 Days Old Shoots	Eluates from Chromatograms of Sugarcane Extracts of 56 Days Old Roots
0.0—0.1	3.4**	5.8
0.1—0.2	3.8**	5.8
0.2—0.3	4.9	5.5
0.3—0.4	5.1	6.2
0.4—0.5	6.1	5.8
0.5—0.6	5.6	5.8
0.6—0.7	5.6	5.2
0.7—0.8	4.8	5.0
0.8—0.9	5.1	5.3
0.9—1.0	5.0	5.3
Controls (distilled water)	5.6	5.6
K Salt of GA 2 micrograms		9.1

* 4950 mgs. dry wt. of sugarcane shoots and 600 mgs. dry wt. of sugarcane roots were represented on the chromatograms.

** Inhibition was statistically significant at .01 level.

A potent inhibitor of rice seedling growth was detected at Rf 0.0 — 0.2 in both of the experiments. The possibility was not eliminated however that the inhibition may have been due to a high concentration of a "growth promoter" at that Rf value. Of interest also was the growth promotion by eluates from Rf 0.3 - 0.4 of chromatograms of the sugar cane root fractions. This growth promotion was noted in both experiments.

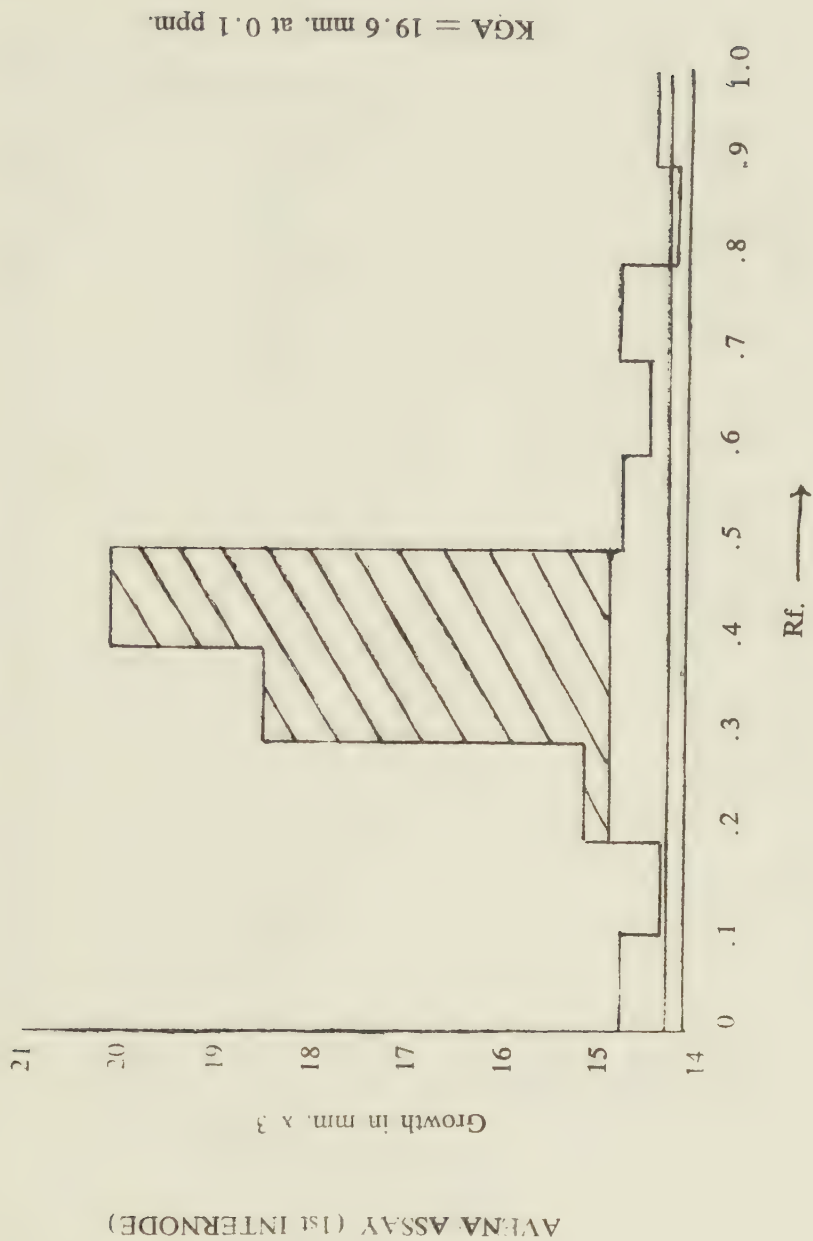
Additional experiments were undertaken to determine the presence or absence of gibberellins in 14 and 42 day-old shoots and roots of cane. In the present series of tests, biological activity on chromatograms was surveyed by means of the rice seedling assay and the oat first-internode bioassay. Extraction and chromatographic procedures and methods of bioassay were similar to those described above. Results are presented in histogram form in Tables 6 to 13.

Table 6



Table 7

14 Day Roots



RICE ASSAY

14 Day Roots

Table 8

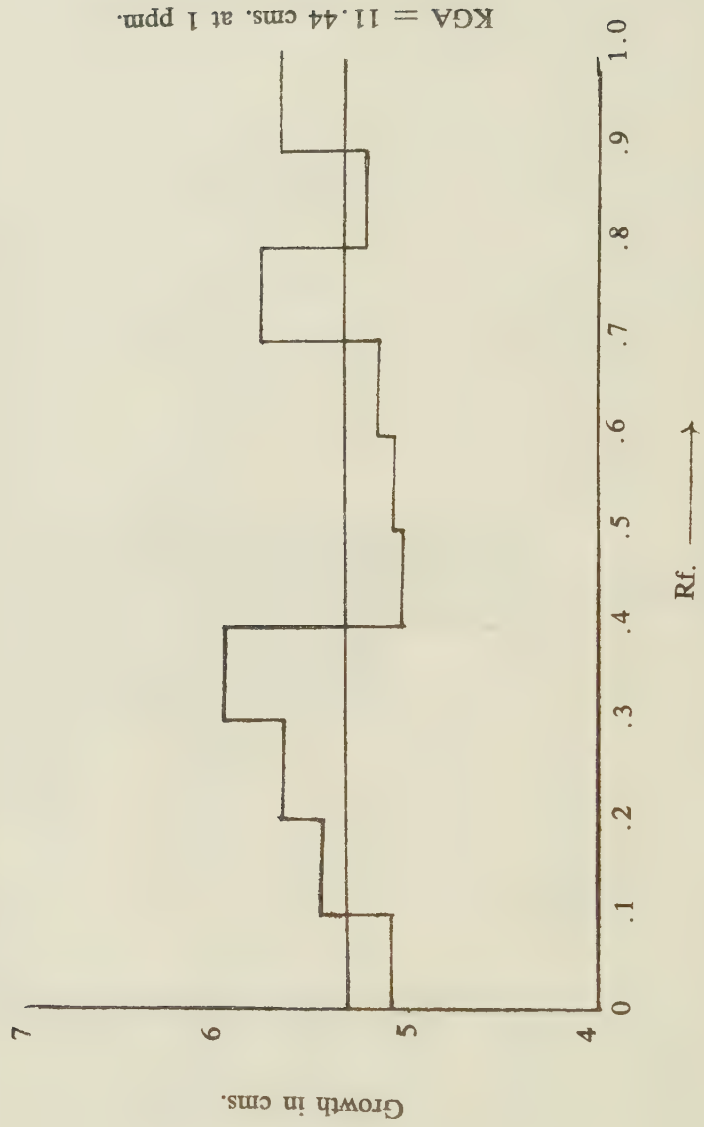
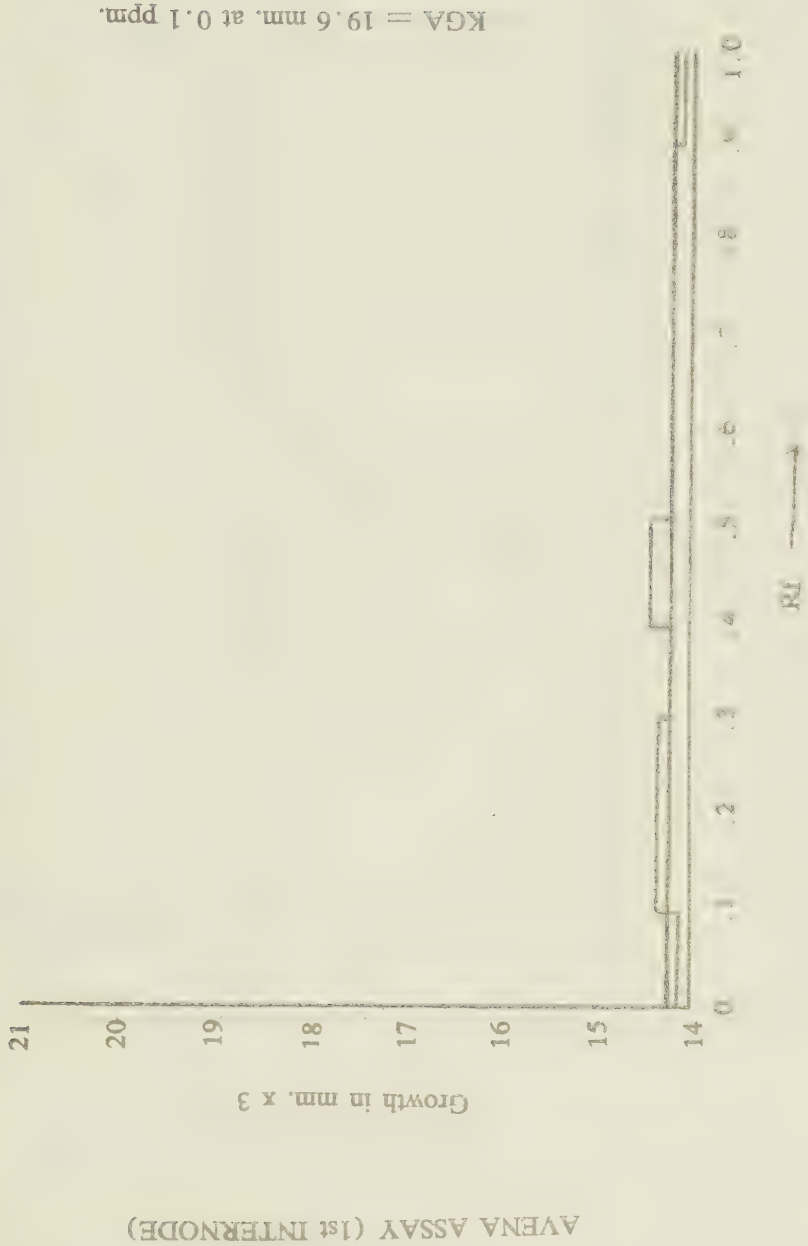


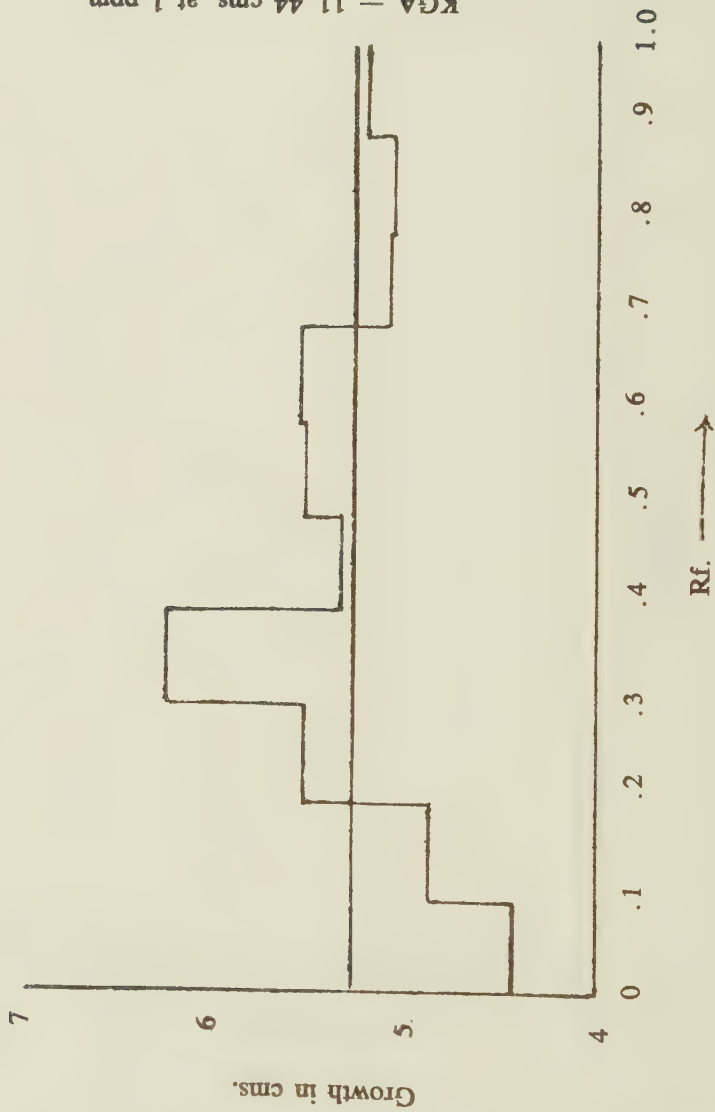
Table 9

14 Day Roots

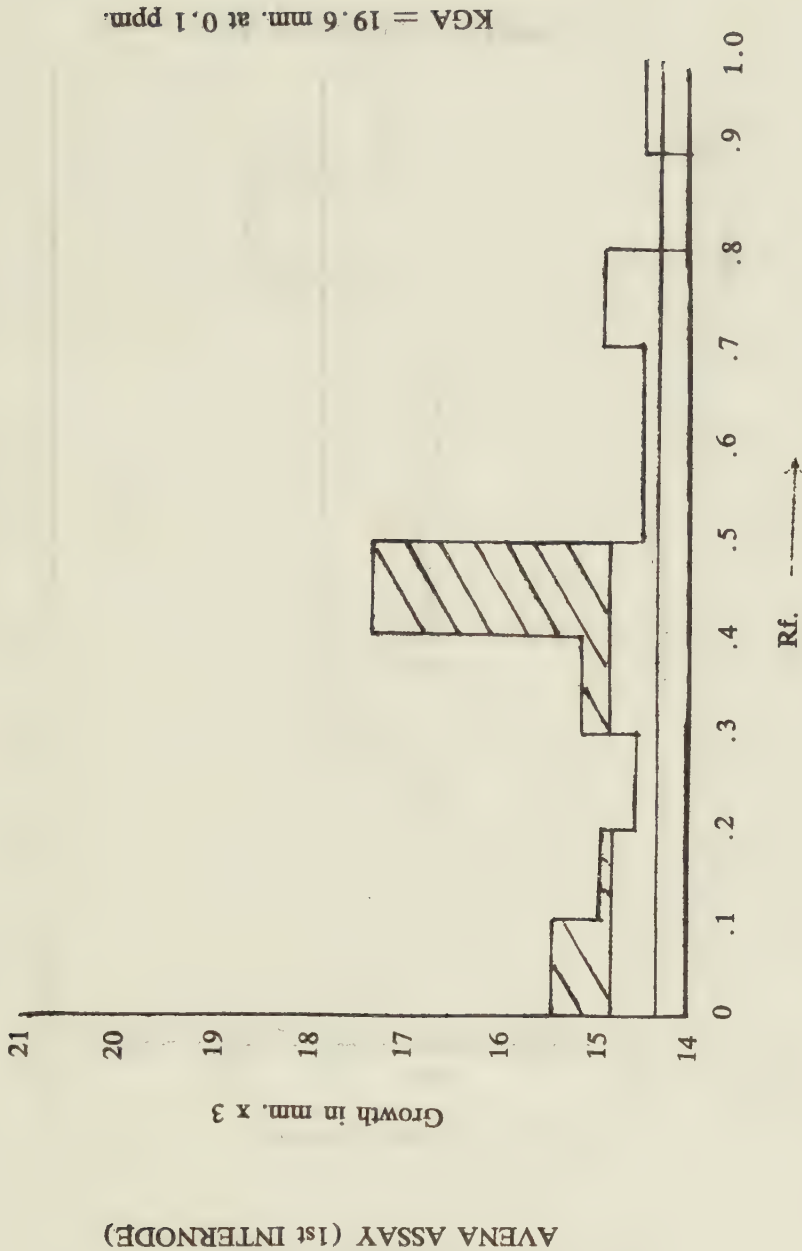


RICE ASSAY

42 Day Shoots
Table 10



42 Day Shoots



RICE ASSAY

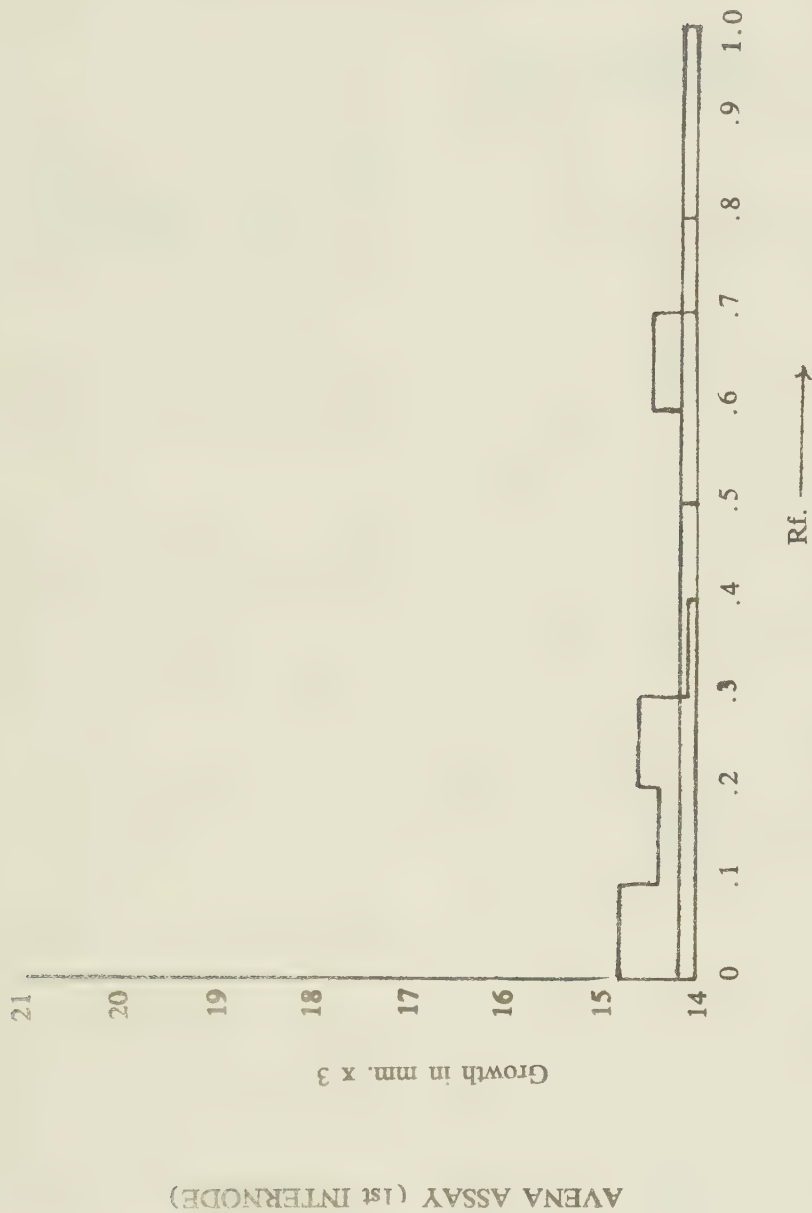
Table 12

42 Days Roots



KGA = 11.37 cms. at 1 ppm.

42 Days Roots



Programme of Research for 1963

B. H. Most

A. Gibberellin-like substances in cane roots and shoots

Preliminary experiments by Vlitos and Cutler have indicated the presence of gibberellin-like substances in shoots of sugar cane but not in the roots. From the preliminary experiments it was thought that this gibberellin-like substance in shoots might possibly be GA₂. Further work is needed to confirm and amplify this result.

Evidence as to the presence and nature of gibberellin-like substances in shoot extracts can be gained in two ways. Firstly, by using thin layer chromatographic separation techniques, and secondly from the relative activity of gibberellins in bioassays.

(i) *Thin layer chromatography for the separation of Gibberellins.* Mac Millan and Suter (1962). (Unpublished data — permission to use this data was kindly given by Dr. P. W. Brian, Director, Pharmaceuticals Division, I.C.I.) Using thin layer chromatography it is possible to separate all 9 gibberellins. The chromatograms after spraying with either:

(a) Ethanol — conc. H₂SO₄ (95:5)

(b) H₂O — conc. H₂SO₄ (30—70)

and heating to 120 degrees C. for 10 minutes should reveal any gibberellins as florescent spots under ultra-violet light.

The sensitivity of this method is high. Both sprays show a similar sensitivity, ranging from 0.00025 micrograms GA₃ to 0.01 GA₆.

The advantages of the method are convenience, speed, and sensitivity. The sulphuric acid sprays which cannot be applied to paper chromatograms are to be preferred to the perchloric acid spray (Kutacek, Rosmus and Deyl 1962), and are more sensitive and specific than the 0.5% aqueous potassium permanganate spray. This latter spray does not detect Gibberellin A₂ and less than 5.0 micrograms or of the other gibberellins.

(ii) *Relative activity of the Gibberellins in Bioassay Tests.* Brian, Hemming and Lowe 1962, Nature, p. 946.

This procedure is based on the knowledge that the nine known gibberellins differ in their sensitivity to a variety of bioassay tests. This difference

in sensitivity can be used to advantage in helping to identify which gibberellin is present in shoot extracts. The bioassay tests which can be used are as follows:

1. Rice seedling assay
2. Dwarf pea stem growth
3. Dwarf maize leaf sheath growth — 3 dwarf mutants
 - (a) d 1
 - (b) d 3
 - (c) d 5
4. Lettuce hypocotyl growth
5. Cucumber hypocotyl growth
6. Lettuce seed germination.

During the search for gibberellin-like compounds in cane shoots by Vlitos and Cutler several interesting facts came to light.

1. The presence of a strong *Avena* first-internode growth promoter at Rf 0.3 — 0.5 in 14 day-old shoots. The activity of this substance falls to a lower value in 42 day-old shoots.

2. The formation of a growth inhibitor, Rf 0.0 — 0.2 in the rice seedling assay. This inhibitor was present in 42 day-old shoots, but absent in 14 day-old shoots. However, this rice seedling growth inhibitor promoted growth in the *Avena* first internode assay.

But these growth active areas will be investigated.

B. Froghopper Programme

This programme will be carried out in co-operation with Dr. Fewkes. Work will be continued in an attempt to identify the growth substances in the saliva of froghoppers.

By using a variety of extraction solvents; water, acetone, ether, ethyl acetate, n-butanol, it is hoped to extract the growth active substance from froghopper saliva.

In the initial experiments, leaves on whole plants will be used as the assay material in preference to first-internode sections or excised leaves. It is possible the salivary glands will have to be collected at various times of the day, e.g., early morning, midday, late afternoon and possibly at night and the saliva examined for

any differences in growth activity.

It would be interesting to know if the saliva from the nymphal stages of froghoppers feeding on cane roots have any growth regulating activity on :

- (a) The growth of cane roots
- (b) Stem growth
- (c) The formation of necrotic area when rubbed on cane leaves.

C. The effect of phenolic acids on growth of cane

A number of phenolic acids have been isolated from sugarcane and have been identified. It is known that certain of these are growth regulants. The possibility exists that the growth regulating activity of phenols is mediated by the tryptophan-IAA growth regulating system. It is planned that field studies with phenolic acids and phenolic glycosides will be carried out to determine a) the influence of these compounds on growth rates of field-grown cane, and b) the effect of these substances on TC/TS ratios early in crop.

B. Foliar Diagnosis As A Guide In Determining Fertilizer Requirements of Sugarcane in Trinidad

A. J. Vlitos
I. D. Lawrie
L. Julien
L. Louis

A comprehensive programme of foliar diagnosis during 1962 led to the establishment of critical leaf index values for N, P, and K. Such index values in future, might be of some practical value in formulating fertilizer practices on the Estates. The analyses were carried out on leaf tissues of sugarcane grown on a number of different soil types. A full account of the programme and results are presented below.

Introduction

The practical aim of foliar diagnosis is to determine the nutritional status of a crop at various periods during its growth, to remedy deficiencies as they are discovered and, thereby, to improve final yields. Before the technique may be applied with precision on a field scale it

is essential to establish inter-relationships between a) the amount of fertilizer applied to the soil in which the crop is to be grown, b) the percentage of major (or minor) elements contained in the tissues of the crop at intervals after the fertilizer has been applied, and c) yields of the crop at harvest.

Several workers (Capo *et.al.* 1955, Clements 1953, Evans 1955, Halais 1948, Innes 1948, du Toit 1953) have shown in sugarcane consistent correlations between foliar analyses, quantity of fertilizer applied to the soil, and tons cane per acre, tons sugar per acre, and cane-juice ratios. The percentages of N, P, and K in leaf tissues of three to seven month-old ratoons or plants considered adequate for maximum yields of sugar in other parts of the world, are summarized in Table 1.

Table 1. Leaf index values considered adequate for maximum yields of sugar in Puerto Rico, South Africa, British Guiana, and Mauritius.

Country	Per cent N,P,K, in Leaf Tissues at 3 to 7 months of age considered adequate for maximum yields of sugar at harvest		
	Nitrogen	Phosphorus	Potassium
Puerto Rico	1.5 — 2.0	0.18 — 0.25	1.65 — 2.00
South Africa	1.25 — 1.45	0.33 — 0.40	1.61 — 1.80
British Guiana	2.2 — 2.3	0.21	1.20
Mauritius	1.6 — 1.8	0.46 — 0.55	1.26 — 1.75

The leaf index values considered adequate for maximum yields of sugar vary with location. Undoubtedly, much of the variation in values is due to differences in varieties, climate, soil type, age of leaf at sampling, and to differences in analytical procedures. Therefore, leaf index values for N,P,K need to be determined, not only in the country in which the crop is grown, but also on several different types of soil and at various locations within the same country. In Trinidad, foliar indices for N,P, or K have not been described previously. Jack (1961) has drawn attention to the need for such data.

During the past three years we have been able to determine at several locations and on six different types of soil, foliar index values for Trinidad-grown sugarcane. Leaf analyses were completed periodically of plant cane and ratoons grown in 3x3x3 factorial fertilizer experiments. It was possible thereby to relate the foliar diagnoses with final yields and with the quantities of fertilizer which had been applied to the experimental plots. The present paper describes the details of the experiments. Foliar indices are presented for

sugarcane grown on several types of soil in Trinidad.

Materials and Methods

The highest visible dewlap was collected at random from each of thirty cane stools growing in plots arranged as 3x3x3 factorials. Collections were made at three, four, five, six, and seven months after reaping in ratoons or after planting in plant cane. Six of the factorial experiments were in ratoons; one experiment was in plant cane. Plot size was 50 feet by four rows of cane, with five feet between the rows, and with ten foot guard rows between plots.

Soil types represented in the experiments were as follows: (1) Piarco series, (2) Freeport clay, (3) Bejucal very heavy clay, (4) Cunupia medium clay and loam, (5) McBean sand and loam, and (6) Frederick very heavy clay. Nomenclature of soil types follows that of Chenery (1949).

Fertilizer treatments consisted of the following:

Sulphate of Ammonia
21%

Treatment

0 = 2 cwt/acre
1 = 4 cwt/acre
2 = 6 cwt/acre

Triple Superphosphate
40% P₂O₅

Treatment

0 = 0 cwt/acre
1 = 2 cwt/acre
2 = 4 cwt/acre

Muriate of Potash
60% K₂O

Treatment

0 = 0 cwt/acre
1 = 2 cwt/acre
2 = 4 cwt/acre

Sulphate of ammonia was applied in two applications, the "first" six weeks after planting, the "second" ten weeks after planting or immediately following reaping of ratoons. Superphosphate was applied in the furrow at planting, while muriate of potash was added to the surface of the soil six weeks after planting, or after reaping in ratoons.

Analytical procedures for the determination

of N,P, and K were as described previously (Annual Report C.A.R.S. 1960-1961).

Results

1. Piarco Series

The inter-relationships between foliar diagnosis, fertilizer dosages, and final yields on the Piarco series are demonstrated in Table 2.

Table 2. Foliar content of P as it relates to final yields of sugarcane on the Piarco series.

Per cent P in highest visible dewlap of 3, 4, 5, 6 and 7-month "old" 2nd ratoons (B 41227) in relation to final yields					
Age at Sampling (Months)	P0	P1	P2	Monthly Rainfall (inches)	
3	.145	.163	.194	6.15	
4	.162	.182	.228	10.57	
5	.158	.205	.215	5.06	
6	.186	.226	.246	6.16	
7	.329	.333	.338	3.83	
<i>Final Yields</i>					
	P0	P1	P2	LSD at	
				.05	.01
Tons cane/acre	1.20	16.55	25.33	2.61	3.61
Tons cane/ton sugar	9.76	9.08	8.43	0.33	0.45
Tons sugar/acre	0.18	1.82	3.03	0.34	0.47

With increasing doses of phosphatic fertilizer, applied in the furrow at planting, there was a corresponding increase in the percentage of P in the highest visible dewlap at three, four, five, six, and seven months. Similarly, there was a corresponding increase at harvest in tons cane per acre, tons sugar per acre, as well as improvements in cane-juice ratios. The relationships between leaf values for P at 3 months, amount of P fertilizer which had been applied to the crop at planting, and final yields were linear (Figure 1).

An analysis of variance revealed highly significant interactions between P x N and K x P with respect to yields expressed as tons sugar per acre.

Maximum yields on the Piarco series were obtained from plots which had received four cwts. per acre superphosphate and when the content of P in the highest visible dewlap at three months was at least .194 per cent. Mini-

mum yields were obtained from plots which did not receive phosphatic fertilizer and when the leaf index was .145 per cent P at three months. Intermediate yields were obtained with two cwts. per acre superphosphate and a leaf value of .163 per cent P at three months.

The content of N and K in leaves of the 2nd ratoons at three months after reaping did not follow the linear pattern shown for P. This was not surprising in view of the severe phosphate deficiency recorded on the Piarco series.

2. Freeport Clay

Two factorial experiments were conducted on Freeport clay. The results of each were similar and therefore only one of the experiments will be discussed in detail.

Highly significant differences in yields were recorded between plots which had received two cwts. per acre and four or six cwts. per acre sulphate of ammonia (Table 3).

Table 3. Foliar content of N as it relates to final yields of sugarcane on Freeport clay.

Per cent N in highest visible dewlap of 4, 5, 6, and 7-month "old" 1st ratoons (B 41227) in relation to final yields				
Age at Sampling (Months)	N0	N1	N2	Monthly Rainfall (inches)
4	2.20	2.64	2.95	7.50
5	1.03	1.42	1.50	5.66
6	1.87	2.13	2.55	4.23
7	1.58	1.60	1.68	4.26
Final Yields				
	N0	N1	N2	LSD at .05 .01
Tons cane/acre	16.71	20.48	26.56	2.38 3.29
Tons cane/ton sugar	13.14	14.20	15.37	0.83 1.15
Tons sugar/acre	1.21	1.46	1.77	0.24 0.33
Age at Harvest : 9 months		Variety : B 41227		

Foliar analyses at four, five, six, and seven months after reaping of plant cane revealed, in the 1st ratoons, increasing percentages of N in the highest visible dewlap with increasing dosages of nitrogenous fertilizer. Maximum yields were obtained from plots where the mean leaf value for N at four months was 2.95 per cent.

Leaf values for P at four months exceeded .283 per cent, a value generally considered adequate for maximum yields of sugar elsewhere

(Evans 1955). Final yields were unaffected by the quantity of superphosphate which had been applied to the plots at planting.

Potash applications (i.e. two or four cwts. per acre muriate of potash resulted in significant increases in yields of sugar (Table 4). Foliar analyses at four, five, six, and seven months showed increasing quantities of K in the highest visible dewlap as the dosage of potash fertilizer was increased (Table 4).

Table 4. Foliar content of K as it relates to final yields of sugarcane on Freeport clay.

Per cent K in highest visible dewlap of 4, 5, 6, and 7 month "old" 1st ratoons (B 41227) in relation to final yields.					
Age at Sampling (Months)	K0	K1	K2	Monthly Rainfall (inches)	
4	1.45	1.66	1.88	7.50	
5	0.94	1.30	1.57	5.66	
6	1.30	1.49	1.60	4.23	
7	1.00	1.16	1.26	4.26	
<i>Final Yields</i>					
	K0	K1	K2	LSD at	
				.05	.01
Tons cane/acre	19.49	22.17	22.09	2.38	3.29
Tons cane/ton sugar	14.70	14.17	13.84	0.83	1.15
Tons sugar/acre	1.26	1.56	1.62	0.24	0.33
Age at Harvest : 9 months		Variety : B 41227			

An analysis of variance revealed highly significant responses to N and K, but interactions between N, P, and K were not statistically significant.

3. Bejucal Very Heavy Clay

Significant yield responses to two and four

Table 5. Foliar content of N as it relates to final yields of sugarcane on Bejucal very heavy clay.

Per cent N in highest visible dewlap of 4, 5, and 6 month "old" 1st ratoons (B 41227) in relation to final yields.					
Age at Sampling (Months)	N0	N1	N2	Monthly Rainfall (inches)	
4	1.72	2.82	2.94	6.08	
5	1.99	2.34	2.53	7.14	
6	2.05	2.40	3.24	5.58	
<i>Final Yields</i>					
	N0	N1	N2	LSD at	
				.05	.01
Tons cane/acre	13.15	16.69	17.13	2.41	3.33
Tons cane/ton sugar	12.15	12.39	12.96	0.83	1.14
Tons sugar/acre	1.10	1.36	1.34	0.39	0.54

Age at Harvest: 9½ months

Variety: B 41227

cwts. per acre sulphate of ammonia were noted on Bejucal very heavy clay. Although tons cane per acre were increased, tons sugar per acre were unaffected. Leaf values for N at four, five, and six months increased in relation to the amount of sulphate of ammonia which had been applied to the plots as fertilizer (Table 5).

P and K did not limit yields of sugar, but tons cane per acre were increased with applications of potash (Table 6). Leaf analyses at four months had indicated adequate levels of P and K in the highest visible dewlap. Analysis of variance showed a highly significant interaction between P and K, and a significant response to N.

Table 6. Foliar content of K as it relates to final yields of sugarcane on Bejucal very heavy clay.

Per cent K in highest visible dewlap of 4, 5, and 6 month "old" 1st ratoons (B 41227) in relation to final yields.					
Age at Sampling (Months)	K0	K1	K2	Monthly Rainfall (inches)	
4	1.33	1.62	1.71	6.08	
5	0.92	1.15	1.25	7.14	
6	1.19	1.32	1.37	5.58	
<i>Final Yields</i>					
	K0	K1	K2	LSD at	
				.05	.01
Tons cane/acre	14.64	16.05	16.28	2.41	3.33
Tons cane/ton sugar	12.37	12.79	12.34	0.83	1.14
Tons sugar/acre	1.19	1.27	1.34	0.39	0.54

Age at Harvest : 9½ months

Variety : B 41227

4. Frederick Very Heavy Clay

Significant responses of plant cane to nitrogenous fertilizer were obtained on Frederick very heavy clay (Table 7).

Table 7. Foliar content of N as it relates to final yields of plant cane on Frederick very heavy clay.

Per cent N in highest visible dewlap of 3, 4, 5, 6, and 7 month old plant cane (B 41227) in relation to final yields.					
Age at Sampling (Months)	N0	N1	N2	Monthly Rainfall (inches)	
3	1.95	2.03	2.12	5.80	
4	1.80	1.87	2.26	6.63	
5	1.77	1.87	2.17	1.66	
6	2.04	1.47	1.33	0.32	
7	1.52	2.03	1.82	1.32	
<i>Final Yields</i>					
	N0	N1	N2	LSD at	
				.05	.01
Tons cane/acre	11.66	12.68	13.91	2.31	3.20
Tons cane/ton sugar	8.78	8.73	8.60	0.22	0.31
Tons sugar/acre	1.33	1.44	1.62	0.18	0.25

Age at Harvest: 9½ months

Variety: B 41227

There were also significant differences in yields of sugar between plots which received 0 and four cwts. per acre superphosphate (Table 8).

Per cent P. in highest visible dewlap of 3, 4, 5, 6, and 7 month old plant cane (B 41227) in relation to final yields.

Per cent P. in highest visible dewlap of 3, 4, 5, 6, and 7 month old plant cane (B 41227) in relation to final yields.				
Age at Sampling (Months)	P0	P1	P2	Monthly Rainfall (inches)
3	.243	.270	.287	5.80
4	.313	.303	.340	6.63
5	.325	.343	.352	1.66
6	.205	.219	.193	0.32
7	.252	.239	.245	1.31

Final Yields

	P0	P1	P2	LSD at	
				.05	.01
Tons cane/acre	11.79	12.92	13.54	2.31	3.20
Tons cane/ton sugar	8.72	8.72	8.53	2.22	0.31
Tons sugar/acre	1.32	1.48	1.58	0.18	0.25

Age at Harvest: 9½ months

Variety : B 41227

Maximum yields were related to a leaf index of .287 per cent P at three months.

Yields were not limited by K. Leaf analysis for K at three and four months had indicated adequate levels.

Analysis of variance for the 3x3x3 factorial on Frederick very heavy clay indicated a significant response to N and P, but not to K. Interactions

between N and K were significant at the .05 level.

5. McBean Sand and Loam

Significant increases in sugar yields were obtained with applications of four cwts. per acre muriate of potash (Table 9).

Table 9. Foliar content of K as it relates to final yields of sugarcane on Mc Bean sand and loam.

Per cent K in highest visible dewlap of 4, 5, 6, and 7 month "old" 1st ratoons (B 41227) in relation to final yields.				
Age at Sampling (Months)	K0	K1	K2	Monthly Rainfall (inches)
4	1.37	1.92	2.09	8.27
5	1.35	1.78	1.78	10.53
6	1.16	1.40	1.62	4.54
7	1.36	1.31	1.46	6.24
Final Yields				
	K0	K1	K2	LSD at .05 .01
Tons cane/acre	29.39	32.71	37.21	5.76 7.97
Tons cane/ton sugar	8.66	8.11	8.52	0.69 0.96
Tons sugar/acre	3.44	4.06	4.38	0.76 1.05

Age at Harvest: 12 months.

Variety: B 41227

Leaf values of 1.92 to 2.09 per cent K at four months were associated with maximum yields at harvest.

N and P did not limit yields. Leaf values for both these elements were well within the adequate range, judging from the analysis of four month-old samples.

Analysis of variance did not indicate any significant interactions between the major elements.

6. *Cunupia Medium Clay and Loam*

Significant responses to N fertilization were obtained on *Cunupia* medium clay and loam (Table 10).

Table 10. Foliar content of N as it relates to final yields of sugarcane on *Cunupia* medium clay and loam.

Per cent N in highest visible dewlap of 3, 4, 5, and 6 month "old" 1st ratoons (B 41227) in relation to final yields.					
Age at Sampling (Months)	N0	N1	N2	Monthly Rainfall (inches)	
3	1.84	1.91	2.36	8.61	
4	2.30	2.52	2.68	9.61	
5	2.01	2.65	2.91	7.15	
6	1.73	2.21	2.38	11.19	
<i>Final Yields</i>					
	N0	N1	N2	LSD at	
				.05	.01
Tons cane/acre	24.06	28.26	29.03	2.52	3.49
Tons cane/ton sugar	8.12	8.52	8.82	0.32	0.45
Tons sugar/acre	2.97	3.32	3.31	0.35	0.48

Age at Harvest : 13 months

Variety : B 41227

Leaf values for N in four-month samples increased with increasing dosages of nitrogenous fertilizer. Maximum sugar yields were obtained from plots treated with two and four cwts. per acre sulphate of ammonia, and in which the

content of N in the leaf at four months exceeded 2.5 per cent.

Applications of K (i.e. four cwts. per acre muriate of potash) also produced statistically significant increases in yields of sugar (Table 11).

Table 11. Foliar content of K as it relates to final yields of sugarcane on Cunupia medium clay and loam.

Per cent K in highest visible dewlap of 3, 4, 5, and 6 month "old" 1st ratoons (B 41227) in relation to final yields.					
Age at Sampling (Months)	K0	K1	K2	Monthly Rainfall (inches)	
3	1.30	1.44	1.55	8.61	
4	1.30	1.48	1.64	9.61	
5	1.04	1.31	1.44	7.15	
6	0.75	0.86	0.87	11.19	
<i>Final Yields</i>					
	K0	K1	K2	LSD at	
				.05	.01
Tons cane/acre	25.63	26.88	28.83	2.52	3.49
Tons cane/ton sugar	8.58	8.40	8.39	0.32	0.45
Tons sugar/acre	2.99	3.18	3.43	0.35	0.48

Age at Harvest : 13 months

Variety : B 41227

A value of 1.64 per cent K in four-month-old leaf samples was associated with maximum yields at harvest. Leaf K increased with increasing dosages of potash fertilizer. Phosphate did not limit yields.

An analysis of variance for the 3x3x3 factorial trial on Cunupia medium clay and loam did not

indicate significant interactions between N,P, or K.

A summary of foliar index values, considered adequate for maximum yields of sugar in ratoons on five different types of soil and in plant cane on Frederick very heavy clay, is presented in Table 12.

Table 12. Summary table showing the minimum percentages of N, P, and K in the highest visible dewlap at 4 months associated with maximum yields of sugar in ratoons grown on several soil types in Trinidad.

Soil Type	Per cent of element in highest visible dewlap at 4 months of age (ratoons)		
	Nitrogen	Phosphorus	Potassium
Mc Bean Sand	2.4	0.29	1.9
Freeport Clay (Waterloo)	2.6	0.28	1.7
Piarco Series (Monjaloux)	1.7	0.20	1.1
Bejucal Very Heavy Clay (Felicite)	1.7	0.29	1.3
Cunupia Medium Clay	2.5	0.26	1.5
Frederick Very Heavy Clay *	2.1	0.27	1.2

* Plant cane at 3 months.

Discussion

In non-irrigated areas, foliar analyses are subject to variation incurred by either prolonged droughts or by excessive rainfall and poor drainage. During the course of the present experiments there was adequate rainfall prior to and during the periods when leaves were being sampled for analysis. Therefore the mobilities of N and K did not appear to be seriously affected by lack of adequate moisture or by poor drainage. In most of the experiments the content of the major elements in the green leaf at three, four, or five months reflected the quantity of fertilizer which had been applied to the plots previously.

The green leaf index values for N, P, or K associated with maximum yields at harvest were governed somewhat by the type of soil on which the crop was grown. For example, on Bejucal very heavy clay only 1.7 per cent N in the four-month-old leaf was associated with maximum yields at harvest, while on Freeport clay a much higher leaf index for N was required (i.e. 2.6 per cent). Similarly, 1.3 per cent K in the green leaf at four months was associated with maximum yields of sugar on Bejucal very heavy clay, but 1.9 per cent K was necessary for the best yields on McBean sand and loam. In general the leaf index for P was approximately the same (i.e. 0.26 — 0.29 per cent) in cane grown on McBean sand and loam, Freeport clay, Bejucal very heavy clay, Cunupia medium clay and loam, and Frederick very heavy clay. On the Piarco series where a severe deficiency of P was recorded, the leaf index associated with maximum yields was .20 per cent in the four-month leaf samples, a value below that for cane grown on other soils. Undoubtedly, yields might be increased on the Piarco series with additional dressings of superphosphate, and a higher leaf index for P might well be established in future

for cane grown on this soil.

With respect to K there was considerable variation in the leaf content of this element, depending upon soil type. On the Piarco series maximum yields were obtained from plots where the mean leaf content was 1.1 per cent at four months, while on McBean sand and loam 1.9 per cent K was associated for maximum yields. On Bejucal very heavy clay, 1.3 per cent K in the four month leaf sample was required for maximum yields of sugar at harvest.

Interestingly, the leaf index values which have been presented as adequate for the best yields of sugar in Trinidad correspond closely to those reported by Evans (1955) for British Guiana.

Additional studies are in progress to establish critical foliar index values for sugarcane grown on Princes Town marl, Talparo clay, and Sevilla clay. The results of such investigations could prove of value in formulating fertilizer practices for sugar cane, as well as for other crops which might be grown on these soils in the future.

Summary

Inter-relationships were found between a) leaf analyses for N, P and K at various stages during the growth of sugar cane, b) quantities of fertilizer applied to the crop, and c) final yields. The foliar index values associated with maximum yields of sugar have been presented for ratoons grown on the Piarco series, Freeport clay, McBean sand and loam, Cunupia medium clay and loam, and Bejucal very heavy clay. Leaf index values have also been presented for plant cane grown on Frederick very heavy clay.

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III. ENTOMOLOGY

D. W. Fewkes

Introduction : The research programme in entomology has been largely concerned with studies in the biology of the sugar cane frog-hopper (*Aeneolamia varia saccharina* Distant), with special reference to the egg stage.

Experiments have been carried out also, to determine the effect of some chemical and physical factors on the hatching of frog-hopper eggs.

Another aspect of the study has dealt with the possible nature and physiology of frog-hopper blight. These experiments were done in co-operation with the plant physiologist.

A short note on the rearing of frog-hoppers in captivity, and a brief review of the literature on the composition of frog-hopper spittle, complete the report.

There are seven sections as listed below :

- A. Studies in the biology of the sugar cane frog-hopper *Aeneolamia varia saccharina* Distant.
 - (1) Fecundity and fertility during the dry season.
 - (2) Egg diapause during the dry season.
- B. The effect of farnesol and phytol on the hatching of frog-hopper eggs.
- C. The effect of exposure to dry conditions on frog-hopper eggs.
- D. The effect of freezing temperatures on the hatching of frog-hopper eggs.
- E. The physiology of frog-hopper blight.
- F. Rearing frog-hoppers in captivity.
- G. The composition of frog-hopper spittle.

A. Studies in the biology of the sugar cane frog-hopper *Aeneolamia varia saccharina* Distant

1. Fecundity and fertility during the dry season

Introduction : A knowledge of the reproductive capacity of an insect is important in understanding its ecology. Up to now, no serious attempts have been made to estimate the fecundity and fertility of the sugar cane frog-hopper. This may be partly due to the difficulty of rearing the insect in captivity through nymph and adult stages. The present work avoids this difficulty by making the required estimates from data obtained by rearing field-collected adults in captivity. This procedure has the additional advantage of revealing any trends in fecundity and fertility during the period of study, if these should occur.

Procedure : Adult frog-hoppers were collected from the field on various occasions over the period 15th December, 1961, to 22nd March, 1962, and caged singly (one female), in pairs (one male plus one female), or in groups (varying numbers of males and females). Single and paired adults were caged in 1 lb. jam jars containing two pieces of sugar cane leaf and a strip of moist filter paper. Groups were caged in large 500 ml. flasks with several lengths of sugar cane leaf and a strip of moist filter paper. All cages were kept in an outdoor insectary at a mean temperature of 26 degrees C (21 to 32 degrees C). The cages were inspected and provided daily with fresh food and filter paper. Where oviposition

had occurred, the filter paper containing the eggs was transferred to a suitably labelled petri dish. Each culture of eggs was kept continually moist and was inspected frequently (1 to 3 days and later at 7-day intervals) for hatching; the eggs being removed from the filter paper and counted as soon as possible. The cultures were maintained in a controlled temperature room at 26 degrees C, or in the outdoor insectary (mean temperature 26 degrees C).

Results : The fecundity of frog-hopper females seems to have been greatly under-estimated, unless wet season adults are less fecund than those occurring in the dry season. Williams (1921) states that 40 to 100 eggs can be laid by one female, and Kershaw (1913) considered, from dissections, that 120 is the maximum fecundity. These observations appear to be concerned with wet season adults. The present work has shown that individual dry season females may lay as many as 294 eggs. Five of 37 females, each caged with one male, laid more than 200 eggs each. The fecundity and longevity (days, in brackets) of these females was: 205(12), 206(13), 271(24), 282(25), and 294(23).

Assuming that eggs are laid at a steady rate throughout the life of a female, the expression, $Y = bX$, will be descriptive of this process where: Y is the number of eggs laid, X is the duration of life, and b is the number of eggs laid per day. Values of X and Y are available for 37

paired (i.e. caged with one male) females collected over the period, 15th December, 1961, to 22nd March, 1962 (see Table 1). These have been used to calculate a simple linear regression of Y (number of eggs laid, + 1 to eliminate zeros) on X (duration of life (days) in captivity). The regression line has the expression :

$$y = 78.41 + 11.37 (x - 7.19),$$

and provides a statistically significant fit for the data, accounting for 73.1% of the total variation ($p < 0.001$).

Thus, if a female frog hopper lives for 3 to 4 weeks she may be expected to lay 239 to 318 eggs.

Similar data for 18 single females collected from 15th January to 14th February, 1962 (Table 2), and analysed in the same way, gave the regression equation :

$$y = 47.28 + 12.65 (x - 4.94).$$

The regression is statistically significant ($p < 0.001$), accounting for 58.6% of the total variance.

Statistical comparison of the two regression coefficients b_1 (paired females) = 11.37 (standard error ± 1.16) and b_2 (single females) = 12.65 (standard error ± 2.66) reveals that they are not significantly different ($n = 53$, $t = 0.447$, $p > 0.05$).

Estimates of fecundity (egg production) are of little value unless the fertility (number of live births) can also be estimated. In nature, eggs may not produce young for several reasons ; they

may be parasitized or destroyed by predators, they may be situated in unfavourable conditions, or they may be infertile. Under the conditions of the present study, two factors were involved ; infertility and developmental failure due to unknown causes. These factors were not distinguished between, but it was noted that infertility accounted for most (80 to 90%) of the failures to hatch.

The eggs varied widely in the incubation period required for hatching, from 14 to over 210 days. For the purpose of estimating fertility, those eggs were ignored which had not hatched after 30 weeks, and were not obviously bad. This involved less than 2% of the total.

The results are set out in Table 3. There is no evidence of a trend in fertility over the period involved although there is considerable variation. The mean fertility of the eggs laid by paired females (one female plus one male) was 88.1% and of those from groups of adults, 92.4%. The fertility of unpaired females was lower (68%). Only one of these females laid no fertile eggs. It would appear that one mating is insufficient for maximum fertility.

Summary : The fecundity (egg production) of frog hoppers during the dry season is estimated at 10 to 12 eggs and the fertility (number of live births) at 9 to 11 eggs per female per day. Individual dry season females lived for one to 25 days and laid nil to 294 eggs. Females may require to mate more than once to achieve maximum fertility.

Table 1.

The fecundity and longevity of female frog hopper adults during the dry season. Values for regression of Y (No. of eggs + 1) on X (duration of life) for paired females

Y (No. of eggs + 1)	X (duration of life, days)
1	1
1	1
1	1
1	1
3	2
1	2
1	2
52	2
1	2
23	3
28	3
53	3
1	3
27	3
30	4
71	5
36	5
112	6
86	6
37	6
130	6
39	7
82	7
50	8
18	8
139	8
169	9
122	10
43	11
195	11
206	12
110	12
207	13
119	15
139	21
295	23
272	24

Table 2.

The fecundity and longevity of female frog hopper adults during the dry season. Values for regression of Y (No. of eggs + 1) on X (duration of life) for single females

Y (No. of eggs + 1)	X (duration of life, days)
1	1
1	2
1	3
1	2
1	2
1	2
1	2
1	2
50	2
24	3
39	3
53	3
54	4
40	7
57	7
10	11
113	11
164	12
240	12

Table 3
The fertility of female froghopper adults during the dry season

Date of Oviposition	Total number of eggs	Eggs not hatched at 30 weeks	Total eggs for estimate of fertility	Number of fertile eggs	Percentage fertility ($\frac{C}{A-B} \times 100$)
(A)	(B)	(A-B)	(C)		
(a) <i>Results for paired adults :</i>					
16/12-21/12/61	145	2	143	127	88
28/12/61-18/1/62	639	19	620	505	81
17/1-26/1/62	432	6	426	412	97
31/1-3/2/62	173	1	172	147	85
16/2-26/2/62	406	6	400	361	90
24/3-14/4/62	658	Nil.	658	578	88
16/12/61-14/4/62	2453	34(1.4%)	2419	2130	88.1
(b) <i>Results for groups of adults :</i>					
1962					
25/1-29/1	660	6	654	576	88
31/1-3/2	114	3	111	105	95
7/2-10/2	129	Nil.	129	123	95
7/2-8/2	240	1	239	223	93
9/2-15/2	328	3	325	291	90
10/2-14/2	890	8	882	784	89
13/2-14/2	106	Nil.	106	92	87
14/2-22/2	1137	11	1126	1061	94
15/2-22/2	540	12	528	504	95
25/2-7/3	547	13	534	505	95
28/2-9/3	1170	8	1162	1118	96
6/3-10/3	507	1	506	472	93
15/3-22/3	171	Nil.	171	149	87
21/3-5/4	580	7	573	508	89
25/1-5/4	7119	73(1.0%)	7046	6511	92.4
(c) <i>Results for single females :</i>					
1962					
16/1-26/1	139	5	134	106	79
31/1-1/2	90	Nil.	90	89	99
15/2-25/2	617	6	611	370	61
16/1-25/2	846	11(1.3%)	835	565	68

A. *Studies in the biology of the sugar cane froghopper*
Aeneolamia varia saccharina Distant

2. *Egg diapause during the dry season*

Introduction:

Froghopper eggs laid during the dry season and maintained under moist conditions require widely varying incubation periods prior to hatching. There is no clear cut distinction between "short term" and "long term" eggs, as hatching occurs at all times from 14 to over 200 days (Urich and Pickles, 1931, Fewkes, 1961). The state of arrested development characteristic of many of these eggs may be termed diapause. It does not seem to be directly related to adverse conditions (i.e. insufficient moisture) as the eggs do not all hatch normally when placed in moist conditions, but require longer periods of incubation. The degree of diapause varies from very weak (almost mere quiescence) to very strong (eggs taking 30 weeks or longer to hatch).

This study is designed to detect any variation in the degree of diapause during the dry season.

Procedure. As for section 1.

Observations and Results

(a) *Morphology of the egg*

When the eggs are laid, they are spindle shaped, slightly rounded at the posterior end, roughly three times as long as broad (0.75 - 0.9 x 0.25 mm), and they are of a uniform, yellow colour. A hatching line is faintly visible, extending from the anterior tip of the egg along approximately half its length (stage A). At a later stage (B), a narrow elliptical area beneath the hatching line becomes black in colour. This is often referred to as the "hatching lid" (Williams, 1921). At a yet later stage (C), the hatching line splits, exposing the "black lid." The egg swells slightly, and pigments of the developing embryo are visible through the egg shell.

All eggs pass through these three stages, but for those eggs in which development is arrested by diapause, the duration of stage B is protracted. In moist conditions at 26°C, stage A normally lasts three to four days and stage C, four to six days. Under the same conditions, stage B may last from seven to over 200 days, depending upon the degree of diapause.

(b) *Variations in the intensity of diapause*

Records of the hatching of eggs laid by individual dry season females indicate that they may

lay eggs which exhibit widely different degrees of diapause, even on the same day. Some typical examples are given in Table 4, representative of the variation encountered during the period of study.

Some measure of the average degree of diapause of a batch of eggs is given by the ratio of the number hatching in a given time to the total number of viable eggs or, if the latter is not known, to the number hatching at some other fixed time. Taking this measurement as a ratio of the number of eggs hatching in 8 weeks to the number hatching in 30 weeks, it may be seen how the degree of diapause varies over the period of observation (Table 5).

Each line in Table 5 refers to eggs laid by several females collected on the same day. The median date of oviposition is indicated in the first column. The third column indicates the day length for each date, and the fourth column the day length at 40 days prior to each date.

The degree of diapause does not seem to be correlated with day length at the time the eggs were laid, but there does seem to be some correlation with the day length at 40 days earlier.

The number of eggs hatching in eight weeks would be directly proportional to the number hatching in 30 weeks if there was no variation in the degree of diapause. Assuming that the degree of diapause is linearly related to day length at 40 days prior to oviposition the regression equation:

$$y = a + b_1 x_1 + b_2 x_2,$$

will be descriptive of the data where;

y = number of eggs hatching in 8 weeks;
 x_1, x_2 = deviations of the independent variables, X_1 (number of eggs hatching in 30 weeks) and X_2 (day length at 40 days before oviposition) from their means;

b_1, b_2 = partial regression coefficients of Y on X_1 and X_2 ;

a = a constant (the mean of all Y values).

This regression equation provides a good fit for the observations. Values for the regression were calculated from the data set out in Table 6. Each line in the table refers to eggs laid by adults collected on one date. The day lengths at 40 days prior to the median date of oviposition were coded by subtracting 11 hours 29 minutes from each in order to simplify computation. The method of computation was that described by

Fisher (1958). All calculations were made to six significant figures, and the final values reduced to two places of decimal.

Regression of *Y* (number of eggs hatching in 8 weeks) on *X*₁ (number of eggs hatching in 30 weeks) and *X*₂ (day length at 40 days prior to median date of oviposition)

$$y = 262.24 + 0.78 (X_1 - 439.06) + 9.02 (X_2 - 6.71)$$

$$b_1 = 0.78 \text{ (standard error } + 0.07)$$

$$b_2 = 9.02 \text{ (standard error } + 3.17)$$

The regression accounts for 90.8% of the total variance (*p* < 0.001), *X*₁ for 83.0% (*p* < 0.001) and *X*₂ for 7.8% (*p* < 0.01). After elimination of the variance due to *X*₁, *X*₂ (day length) accounts

for 45.8% of the remaining variance.

Thus it seems that the degree of diapause of frog hopper eggs is correlated with day length at about 40 days prior to oviposition, that is, at some time during the nymphal stage.

Summary

Eggs laid by dry season frog hopper females exhibit varying degrees of diapause. Individual females may lay eggs requiring widely different incubation periods for hatching, even on the same day. The average intensity of diapause seems to be correlated with the photoperiod occurring at some time during the nymphal stage.

Table 4

Hatching of eggs laid by individual frog hopper females during the dry season

Female No.	Date of Oviposition	No. of eggs hatching during the period (weeks) after oviposition					
		1-4	5-8	9-12	13-16	17-20	21-24
6	30/12/61	52	3	2	2	1	1*
2	2/1/62	2	4	4	5	4	1
4	9/1/62	Nil	1	8	11	5	1
18	17/1/62	Nil	5	8	13	5	3
20	23/1/62	Nil	Nil	1	7	11*	—
35	31/1/62	Nil	Nil	1	16	15	6
47	16/2/62	Nil	4	30	3*	—	—
42	25/2/62	Nil	11	15	10*	—	—
64	25/3/62	2	24	4*	—	—	—
66	27/3/62	26	11	8*	—	—	—

* Hatch complete.

Table 5

*Variation in the degree of diapause of eggs laid by dry season
frog hopper females*

Median date of oviposition	Degree of diapause (No. of eggs hatching in 8 weeks/No. hatching in 30 weeks)	Day length	
		(a) On median date of oviposition	(b) At 40 days earlier
* 19/12/61	0.6	11 hr. 30 min.	11 hr. 40 min.
* 7/1/62	0.6	11 hr. 32 min.	11 hr. 34 min.
* 21/1/62	0.3	11 hr. 36 min.	11 hr. 31 min.
+ 27/1/62	0.4	11 hr. 38 min.	11 hr. 31 min.
+ 2/2/62	0.2	11 hr. 40 min.	11 hr. 31 min.
* 2/2/62	0.3	11 hr. 40 min.	11 hr. 31 min.
+ 8/2/62	0.7	11 hr. 42 min.	11 hr. 30 min.
+ 9/2/62	0.1	11 hr. 44 min.	11 hr. 31 min.
+ 12/2/62	0.6	11 hr. 44 min.	11 hr. 32 min.
+ 12/2/62	0.4	11 hr. 44 min.	11 hr. 32 min.
* 21/2/62	0.6	11 hr. 49 min.	11 hr. 34 min.
+ 2/3/62	0.5	11 hr. 56 min.	11 hr. 36 min.
+ 5/3/62	0.9	11 hr. 58 min.	11 hr. 36 min.
+ 8/3/62	0.7	12 hr. 00 min.	11 hr. 38 min.
+ 19/3/62	0.5	12 hr. 05 min.	11 hr. 42 min.
+ 21/3/62	0.7	12 hr. 07 min.	11 hr. 47 min.
* 4/4/62	1.0	12 hr. 15 min.	11 hr. 15 min.

* Lumped results from individual females
+ Results from groups.

Table 6

Diapause of the frog hopper egg and day length 40 days prior to oviposition. Values for the regression of Y (number of eggs hatching in eight weeks) on X1 (number hatching in 30 weeks) and X2 (photoperiod 40 days prior to oviposition)

Median date of oviposition	Number of eggs hatching in 8 weeks (Y)	Number of eggs hatching in 30 weeks (X1)	Day length at 40 days before oviposition minus 11 h. 29 m. (X2)
19/12/61	77	134	11
7/1/62	237	413	5
21/1/62	161	518	2
27/1/62	253	576	2
2/2/62	20	105	2
2/2/62	72	236	2
8/2/62	161	223	1
9/2/62	13	123	2
12/2/62	461	784	3
12/2/62	107	291	3
21/2/62	409	731	5
2/3/62	240	505	7
5/3/62	952	1118	7
8/3/62	308	472	9
19/3/62	75	149	13
21/3/62	351	508	18
4/4/62	561	578	22

B. The effect of farnesol and phytol on the hatching of frog hopper eggs

Introduction : Farnesol has been found to have a "juvenile hormone" effect when applied to the surface of the cuticle of *Rhodnius prolixus* (Hemiptera, Reduviidae). That is, (a) it "causes retention of larval characters in the moulting fifth stage larva", (b) "it brings about a partial reversal of metamorphosis in the moulting adult", and (c) "it induces yolk formation in the decapitated adult female", (Wigglesworth, 1961).

It is intended to investigate the effect of farnesol on the development of frog hopper nymphs. However, until nymphs can be reared successfully in captivity, and until sufficient numbers are available for experiments, such studies cannot be carried out throughout the

year. Therefore, as a preliminary step, it was decided to investigate the effect of farnesol and of a related compound, phytol, on the viability and hatching of frog hopper eggs.

Methods : Eggs were obtained by caging adult frog hoppers with pieces of sugar cane leaf for food and wads of moist filter paper as a substrate for oviposition. The eggs were extracted mechanically from the filter paper by means of fine forceps, counted and set out on moist filter paper in petri dishes.

The eight experiments described herein are fairly crude in nature, as methods of application of farnesol and formulation methods have not been experimented with. For experiments 1, 3, 4, 5, 7 and 8, pure liquid farnesol or phytol

(experiment 8) was applied to the eggs individually as a drop on the rounded end of an entomological pin. In experiment 2, the eggs were immersed in pure farnesol for 5—10 minutes, and in experiment 6 they were placed on filter paper which had just been treated with pure farnesol. Experiments 1—6 were performed in the laboratory light room at 25—26 degrees C; experiments 7 and 8 were set up in an outdoor insectary at 21 to 31 degrees C (mean, 26 degrees C).

The eggs used in the experiments were laid during December, 1961, and January, 1962 (experiments 1—6), and in July and August, 1962 (experiments 7 and 8). Any eggs treated at stages "A" (hatching line faintly visible) and "B" ("black lid" visible but not exposed by the splitting of the hatching line) could have been in diapause at the time of application (see section A (2), under: *Morphology of the egg*). Those treated at "stage C" (hatching line split, "black lid" exposed) would have completed diapause development, if any was necessary. These points are important in interpretation of the results.

The Experiments

Experiment 1.

Material 27 eggs laid by female (5a) 16/12/61.

Date of application 18/12/61; eggs 2 days old, "stage A".

10 (5 + 5) eggs were placed on dry filter paper, allowed to dry for a few minutes, and then treated each with a drop of pure farnesol. The filter paper was moistened after application.

10 (5 + 5) eggs were placed on moist filter paper and treated each with a drop of pure farnesol.

7 eggs were left untreated on moist filter paper.

All cultures were kept continually moist from the date of application until hatching was complete.

Results (See Table 7)

Hatching of the untreated eggs started in the 11th week after oviposition, and was completed in the 40th week; all seven eggs hatching. None of the treated eggs hatched before the 17th week, and hatching was incomplete by the 40th week. Three of the treated eggs were infertile or were killed by the treatment.

Experiment 2.

Material 53 eggs laid by female (1a) 17—18/12/61.

Date of application 18/12/61, eggs 0—1 day old, "stage A".

20(10+10) eggs were immersed in pure farnesol for 5 to 10 minutes, removed, and placed on moist filter paper.

20(10+10) eggs were left untreated on moist filter paper.

13 eggs were not included in the experiment.

The eggs were maintained in moist conditions throughout the experiment.

Results (See Table 8).

Hatching of the untreated eggs commenced in the third week after oviposition and was complete by the 20th week. One of the eggs was infertile. The treated eggs began to hatch in the fifth week. Hatching was incomplete at 40 weeks. Four eggs were infertile or were killed by the treatment.

Experiment 3.

Material 22 eggs laid by female (1a) 16/12/61.

Date of application 27/12/61, eggs 11 days old, "stage C".

11 eggs on moist filter paper were treated each with a drop of pure farnesol.

11 eggs on moist filter paper were left untreated.

All eggs were kept continually moist.

Results

All the untreated eggs hatched between 31/12/61 and 4/1/62, at 15 to 19 days after oviposition. Six of the treated eggs hatched by 1/1/62 (16 days after oviposition), but no further hatching occurred. The five remaining eggs became discoloured, blackish-brown between 28/12/61 and 1/1/62 (1 to 5 days after application), and were apparently destroyed by the treatment.

Experiment 4.

Material. 30 eggs laid by female (3a) 17—18/12/61.

Date of application. 27/12/61; eggs 9—10 days old, 14 eggs at "stage C" (16 eggs, one at "stage B", 15 infertile, were not used in the experiment).

7 eggs on moist filter paper were treated each with a drop of pure farnesol.

7 eggs on moist filter paper were left untreated.

All eggs were kept continually moist.

Results

All the untreated eggs hatched between 2/1/62 and 3/1/62 (15 to 17 days after oviposition). None of the treated eggs hatched. They became discoloured blackish-brown and were apparently killed by the treatment.

Experiment 5.

Material. 57 eggs laid by female (2a) 19/12/61.

Date of application. 27/12/61, eggs 8 days old, "stage B".

19 eggs on moist filter paper were treated, each with a drop of pure farnesol.

38(19+19) eggs were left untreated.

All eggs were maintained under moist conditions.

Results (See Table 9).

Hatching of the two batches of untreated eggs commenced in the 8th and 7th weeks after oviposition, and was complete by the 28th and 33rd weeks, respectively. The treated eggs commenced hatching in the 8th week, but hatching was incomplete at the 45th week. Two of the untreated eggs were infertile, but all of the treated eggs were fertile.

Experiment 6.

Material. 68 eggs laid by female (1), 1/1/62, plus 2 eggs laid by female (b), 1/1/62.

Date of application. 14/1/62, eggs 13 days old, "stage C".

35 eggs were placed on a strip of filter paper which had been treated just previously with approximately one ml. pure farnesol.

35 eggs were placed on a similar untreated strip of filter paper.

Both strips of filter paper were moistened with water and kept moist during the experiment.

Results

34 of the 35 untreated eggs hatched between 15/1/62 and 18/1/62 (14 to 17 days). One egg failed to develop, and died. None of the treated eggs hatched, all became discoloured blackish brown and were apparently killed by the treatment.

Experiment 7.

Material. 46 eggs laid by a group of adults. 7/7/62. One egg was infertile.

Date of application.

(a) 10/7/62; eggs 3 days old, "stage A"

(b) 13/7/62; eggs 6 days old, "stage B"

15 eggs on moist filter paper were treated each with one drop of pure farnesol at 10/7/62.

15 eggs on moist filter paper were treated each with one drop of pure farnesol on 13/7/62.

15 eggs on moist filter paper were left untreated.

All eggs were kept moist throughout the experiment.

Results (See Table 10).

All 15 untreated eggs hatched in the third and fourth weeks. In the same period seven of each of the two groups of treated eggs hatched.

Hatching of those eggs treated on 10th July was completed in the 14th week; two eggs were killed by the treatment. Three eggs were killed by the application of 13th July. All but one of the remaining eggs had hatched by the 15th week.

Experiment 8.

Material. 48 eggs laid by female (C3), 4/8/62.

Date of application. 15/8/62, eggs 11 days old, "stage B"

24(12+12) eggs on moist filter paper treated each with a drop of pure phytol.

24(12+12) eggs on moist filter paper left untreated.

The cultures were kept moist throughout the experiment.

Results (See Table 11).

Hatching of the untreated eggs was complete by the 5th week. In the same period, 10 of the 24 treated eggs hatched and 10 others died. No further hatching had occurred by the end of the 16th week.

Summary and Discussion

For those experiments in which the eggs were treated at stages "A" or "B", farnesol appeared to have a delaying effect on hatching (experiments 1, 2, 5, and 7). No significant effect on the viability of the eggs was noted. For phytol (experiment 8) the ovicidal effect seems more pronounced than any delaying effect.

In the experiments where the eggs were treated at "stage C", (experiments 3, 4, and 6), farnesol usually killed the eggs, although six of eleven eggs in experiment 3 survived treatment.

If farnesol acts by penetrating the egg shell, as seems likely, it may be that eggs at "stage C" are much more pervious to the chemical than those at stages A and B. Thus they would receive a quite heavy dose of farnesol, usually sufficient to destroy them.

Eggs at stage A and B may take up farnesol more slowly. Possibly, they can tolerate small

quantities of the chemical which therefore has not an ovicidal effect but a delaying effect upon development of the egg.

If it is true that farnesol and phytol can penetrate into frog hopper eggs, it might be possible to use them as "carriers" to take insecticides into the eggs. It is hoped to follow up this possibility in the coming year.

Table 7
The effect of farnesol on frog hopper eggs

Time in weeks from oviposition date (16/12/61)	Number of eggs hatched (cumulative)		
	(a) 10 (5+5) eggs (Farnesol applied to eggs on dry filter paper)	(b) 10(5 + 5) eggs (Farnesol applied to eggs on moist filter paper)	(c) 7 eggs (untreated)
	(18/12/61 Treatments applied)		
10	—	—	—
11	—	—	2
12	—	—	2
13	—	—	3
14	—	—	4
15	—	—	4
16	—	—	4
17	—	2(2 + 0)	4
18	—	3(2 + 1)	4
19	1(1 + 0)	3(2 + 1)	4
20	1(1 + 0)	3(2 + 1)	4
25	5(4 + 1)	6(3 + 3)	6
30	7(4 + 3)	7(3 + 4)	6
35	7(4 + 3)	9(4 + 5)*	6
40	7(4 + 3)		7*
	(2 eggs dead)	(1 egg dead)	

* Hatch complete.

Table 8
The effect of farnesol on frog hopper eggs
Results of Experiment 2.

Time in weeks from oviposition date (17-18/12/61)	Number of eggs hatched (cumulative)	
	(a) 20(10+10) eggs treated with farnesol	(b) 20(10+10) eggs left untreated
	(18/12/61 treatments applied)	
2	—	—
3	—	8(4 + 4)
4	—	8(4 + 4)
5	1(0 + 1)	9(4 + 5)
10	6(3 + 3)	11(5 + 6)
15	10(6 + 4)	16(8 + 8)
20	14(8 + 6)	<u>19</u> (9 + 10)*
25	14(8 + 6)	
30	15(8 + 7)	(1 egg dead)
40	15(8 + 7)	
	(4 eggs dead)	

* Hatch complete.

Table 9
The effect of farnesol on frog hopper eggs
Results of Experiment 5.

Time in weeks from oviposition date (19/12/61)	Number of eggs hatched (cumulative)		
	(a) 19 eggs treated with farnesol	(b) 38(19+19) eggs left untreated	
	(27/12/61 treatment applied)		
6	—	—	—
7	—	—	1
8	1	1	2
9	1	2	2
10	2	3	2
15	6	9	8
20	12	13	12
25	18	17	16
30	18	<u>18*</u>	17
35	18		<u>18*</u>
40	18	(1 egg bad)	
45	18	(1 egg bad)	

* Hatch complete.

Table 10
The effect of farnesol on froghopper eggs
Results of Experiment 7.

Time in weeks from oviposition date (7/7/62)	Number of eggs hatched (cumulative)		
	(a) 15 eggs left untreated	(b) 15 eggs treated with farnesol 10/7/62	(c) 15 eggs treated with farnesol 13/7/62
2	—	—	—
3	13	6	6
4	15*	7	7
5		7	7
13		7	7
14		13*	11
		(2 eggs dead)	
20			11
			(3 eggs dead)

* Hatch complete.

Table 11
The effect of phytol on froghopper eggs
Results of Experiment 8.

Time in weeks from oviposition date (4/8/62)	Number of eggs hatching (cumulative)	
	(a) 24(12+12) eggs treated with phytol	(b) 24(12+12) eggs left untreated
	15/8/62 treatment applied)	
2	2(0 + 2)	3(1 + 2)
3	7(3 + 4)	18(11 + 7)
4	10(4 + 6)	24(12 + 12)*
10	10	
16	10	
	10(6 + 4) eggs dead	

* Hatch complete

C. The effect of exposure to dry conditions on frog hopper eggs

Introduction

The ecology of the sugarcane frog hopper is greatly influenced by the moisture content of the soil. During the dry season when soil moisture is generally at a very low level, the frog hopper population is largely in the egg stage. Thus it would seem that the eggs must be fairly resistant to dry conditions if they are to survive. The experiments described herein were designed to discover the effect on frog hopper eggs of exposure to dry conditions.

Methods and materials

Eggs were obtained by caging frog hopper adults in one pound jam jars with two pieces of sugar cane leaf for food and a wad of moist filter paper for egg laying. The eggs were extracted from the filter paper by means of fine forceps, counted, and set out on moist filter paper in petri dishes. Three experiments were carried out, two with eggs exhibiting strong diapause, one with eggs showing no evidence of diapause.

Experiment 1.

Material. 38 eggs laid by female (3) 29/12/61, and maintained in moist conditions at 25—26 degrees C. One egg hatched at 22 days after oviposition, and one egg was infertile. 35 eggs had not hatched at 40 days; 34 of these eggs were used in experiment.

Procedure. The 34 eggs were separated at random into two equal groups of 17 eggs on 7th February, 1962, 40 days after oviposition. One of these groups was maintained under moist conditions throughout the experiment. The other group was transferred to dry filter paper in an open petri dish and kept in dry conditions (relative humidity 30—40%) for 10 days. At this time the filter paper was moistened. A petri dish cover was placed on the dish and the eggs were kept moist until hatching was complete.

Results (See Table 12).

The eggs exposed to dry conditions for 10 days hatched from the 10th to the 20th week after oviposition. Those kept continuously moist did not commence hatching until the 12th week, and only three of the 17 had hatched by the 21st week. Hatching was almost complete (16 eggs hatched) by the 34th week.

Experiment 2.

Material. 47 (25 + 22) eggs laid by females (2a) and (4a), 17—18/12/62 and cultured in moist conditions at 25—26 degrees C. One egg (female 2a) hatched on the 40th day and two eggs (female 4a) were infertile. No further hatching had occurred by 9th February, 1962 at 54 days from oviposition.

Procedure. 22 eggs (12 from female (2a) and 10 from female (4a)) were retained in moist conditions. 22 eggs (12 (female 2a) plus 10 (female 4a)) were placed on dry filter paper in an open petri dish and maintained in dry conditions for 20 days. On 1st March, 1962, these eggs were returned to moist conditions and kept moist until hatching was complete.

Results (See Table 13).

Hatching of the eggs kept dry for 20 days started later (14 weeks) than for those retained in moist conditions (11 weeks) but proceeded at a more rapid rate up to the 20th week.

Experiment 3.

Material. 150 eggs laid by a group of adults 8/7/62, and kept in moist conditions in an insectary at 21 to 32 degrees C, (mean 26 degrees C).

Procedure. On 14th July, 1962, six days after oviposition, the eggs were separated at random into 5 equal groups of 30 eggs each. The eggs were quite well developed with the "black lid" visible beneath the intact hatching line. ("Stage B", see section A(2), under: *Morphology of the egg*). One batch of eggs was retained in moist conditions. The other four batches were transferred to dry filter paper in an open petri dish and one kept in dry conditions for each of 2, 4, 8, and 16 days. After remoistening the eggs were maintained in moist conditions until hatching was complete.

Results (See Table 14).

Exposure of these non-diapause eggs to dry conditions delayed hatching, but did not appear to affect the viability of the eggs. Three of the 150 eggs had not hatched at 140 days, so that it is difficult to compare the treatments on a total hatch basis. The times taken to achieve a 90% hatch for each treatment (days of exposure to dry conditions, in parenthesis are: 17(Nil), 18(2), 20(4), 25(8), and 36(16).

Summary and Conclusions

Exposure to dry conditions for two to 20 days does not seem to significantly affect the viability of frog hopper eggs. The effect of drying on diapause eggs is different from that on non-diapause

eggs. Keeping diapausing eggs dry for 10 and 20 days markedly accelerates their hatching; that is, it tends to break diapause. Exposure to dry conditions of non-diapause eggs for 2 to 16 days delays hatching by approximately the time of exposure.

Table 12

The effect of exposure to dry conditions on frog hopper eggs

Results of Experiment 1.

Time in weeks from oviposition date (29/12/62)	Number of eggs hatched (cumulative)	
	17 eggs kept dry for 10 days	17 eggs kept continuously moist
	(7/2/62 — eggs transferred to dry conditions)	
	(17/2/62 — eggs re-moistened)	
9	—	—
10	1	—
11	2	—
12	5	1
13	6	1
14	6	1
15	9	1
20	17*	3
25		9
30		14
35		16
40		16

* Hatch complete.

Table 13
The effect of exposure to dry conditions on frog hopper eggs
Results of Experiment 2.

Time in weeks from oviposition date (17-18/12/62)	Number of eggs hatched (cumulative)	
	22 eggs kept dry for 20 days	22 eggs kept continuously moist
	(9/2/62 eggs transferred to dry conditions) (1/3/62 eggs re-moistened)	
10	—	—
11	—	1
12	—	1
13	—	1
14	4	3
15	11	3
20	19	10
25	20	14
30	20	19
40	20	21
	(1 egg dead)	

Table 14
The effect of exposure to dry conditions on frog hopper eggs
Results of Experiment 3.

Time in days from oviposition date (8/7/62)	Number of eggs hatched (cumulative)				
	Eggs exposed to dry condition for (days)				
	Nil	2	4	8	16
15	—	—	—	—	—
16	17	1	—	—	—
17	27	20	—	—	—
18	28	28	—	—	—
19	28	30*	16	—	—
20	28		28	—	—
21	28		29	—	—
22	28		29	—	—
23	28		29	13	—
24	28		29	26	—
25	28		29	30*	—
26	29		29		—
27	29		29		—
28	29		29		—
29	29		30*		—
30	29				—
31	29				2
32	29				7
33	29				15
34	29				20
35	29				26
36	29				27
37	29				28
38	29				28
140	29				28

* Hatch complete

*D. The effect of freezing temperatures on the
hatching of frog hopper eggs*

Introduction

Release from diapause in temperate climates is often favoured by exposure of a diapausing insect to low temperatures. Under tropical conditions freezing temperatures are not encountered under natural conditions but it was nevertheless of interest to examine low temperature effects on a tropical species.

Procedure. 79 eggs laid by one female on 18th January, 1962, were maintained in moist conditions at 25 to 26 degrees C. By 2/3/62, 43 days after oviposition, three eggs had hatched. The 76 eggs remaining were all at "stage B" (see section A (2) Under: *Morphology of the egg*) and were, or had been, in diapause. Four eggs were not included in the experiment for which 72 eggs were required.

- 18(9+9) eggs received no treatment.
- 18(9+9) eggs were kept at -3 to -4 degrees C for 16 minutes.
- 18(9+9) eggs were kept at -3 to -4 de-

grees C for 32 minutes.
18(9+9) eggs were kept at -3 to -4 degrees C for 70 minutes.

Results (See Table 15).

All eggs subjected to the freezing temperature for 70 minutes were killed by the treatment. The eggs were discoloured dark brown within 24 hours. Only one of the eggs survived to hatch of those kept at -3 to -4 degrees C for 32 minutes. Hatching of the untreated eggs and of those chilled for 16 minutes was complete, and there was no significant difference in the hatching pattern of the treated and untreated eggs.

Summary

Exposure to freezing conditions affected the viability of frog hopper eggs when the treatment exceeded 32 minutes. A 16 minute exposure did not kill the eggs, neither did it act to break diapause.

TABLE 15
The effect of freezing temperatures on frog hopper eggs

Time in weeks from oviposition date (18/1/62)	Number of eggs hatched (cumulative)			
	Eggs kept at -3 to -4°C for :			
	(a) (Nil) min. (9+9 = 18 eggs)	(b) 16 min. (9+9 = 18 eggs)	(c) 32 min. (9+9 = 18 eggs)	(d) 70 min. (9+9 = 18 eggs)
	(2/3/62 — treatments applied)			
7	—	—	—	— *
8	1(0+1)	1(1+0)	—	
9	1	4(4+0)	—	
10	1	4	—	
11	2(1+1)	4	—	
12	3(2+1)	4	—	
13	7(2+5)	6(4+2)	1(0+1)*	
14	8(2+6)	10(6+4)		
15	12(5+7)	13(6+7)		
16	13(6+7)	13		
17	15(8+7)	15(7+8)		
18	16(8+8)	15		
19	16	15		
20	18(9+9)*	16(8+8)		
21		17(9+8)		
22		17		
23		18(9+9)*		
			(17 eggs dead)	(18 eggs dead)

* Hatch complete.

E. The Physiology of Froghopper Blight

D. W. Fewkes
H. G. Cutler

When froghopper adults feed on sugar-cane leaves, they cause "blight"; a browning and drying up (i.e. necrosis) of the leaves which spreads from the points at which the insects pierce the leaves in order to feed. This spread of damage from the point of entry of the insect's mouth-parts takes place over 3 to 4 weeks, and the total destruction of leaf tissue resulting from a single puncture is reported to sometimes exceed half a square inch (Williams, 1921). This spread of injury in the leaf from the original feeding puncture indicates the possibility that a viral infection, a toxin or an enzyme is introduced into the leaf during feeding. A toxin or enzyme would presumably occur in the salivary secretion of the adult froghopper, and therefore should be present in the salivary glands.

In a few exploratory experiments, extracts of salivary glands from adult froghoppers were bioassayed for their effect upon plant growth in the "*Avena* test" (Nitsch and Nitsch, 1956; see also C.A.R.S. Annual Report 1960—1961 under Plant Physiology). Salivary glands were dissected from living adult froghoppers, immobilized by keeping them at 0 degrees C for 10 to 30 minutes, and placed in small quantities of acetone, 2% sucrose solution in water, or distilled water, as required. Unless otherwise stated, the 2% sucrose solution and the distilled water used in the experiments, were buffered with a phosphate-citrate buffer at pH 5.6.

Extracts of the salivary glands were prepared as follows. In all cases, adult froghoppers were used.

1. *Chromatography in acetone and water*: Freshly dissected salivary glands of 9 female and 12 male froghoppers were collected separately in acetone and crushed in concentrated spots on the base line of a strip of chromatographic paper (Whatman No. 3). The chromatogram was run in acetone water, 70:30 solution, ascending to a height of 25.5 cm. On drying, the treated strip of the chromatogram was divided vertically into 10 equal segments, and these, as well as one similar sized segment taken at random from the untreated strip of the chromatogram, were eluted, each in 2 ml. 2% sucrose solution. The eluates were bioassayed in the *Avena* first internode straight growth test.

Two other experiments were performed in which salivary glands of 10 female froghoppers were similarly chromatographed. Eluates from

Rf 0.9 to 1 of these chromatograms were used to prepare dilution series in 2% sucrose solution. The various dilutions were bioassayed in the *Avena* first internode test. In one experiment a segment of the untreated strip of the chromatogram, taken at random, was used as a control. In the other experiment, the segment of the chromatogram untreated strip corresponding to the Rf 0.9-1 position served as the control.

The results of these experiments are set out in Table 16. In each chromatogram, the eluates from Rf 0.9-1 inhibited growth of 4 mm. sections of *Avena* mesocotyl. The inhibition observed is statistically highly significant ($p < 0.01$). There seems to be no real difference between the extracts from male and female salivary glands.

2. *Chromatography in water*: Salivary glands of 10 female froghoppers were collected into distilled water and were chromatogrammed in distilled water. Eluates were prepared from the chromatogram as above, and bioassayed in the *Avena* test. The results, presented in Table 17, failed to show any effect of the extracts on growth of *Avena* mesocotyl sections.

3. *Aqueous extracts*: (a) Salivary glands from 5 male froghoppers were macerated in 4 ml. 2% sucrose solution. The resulting extract was divided into two equal volumes. A pair of extracts from the salivary glands of two female froghoppers was similarly prepared. These 4 extracts together with 2 ml. of an untreated 2% sucrose solution were bioassayed in the *Avena* test. The results are presented in Table 18. The salivary gland extracts caused a very strong promotion of growth in the *Avena* sections. The sections floated in salivary gland extracts grew to 176 — 190% the length of the control sections.

The experiment was repeated, using similarly prepared extracts from the salivary glands of 5 males. Promotion of growth again occurred in the sections floated in gland extract, but the degree of promotion was far less than in the previous experiment (see Table 18).

(b) Salivary glands of 27 male froghoppers were collected into distilled water (unbuffered), macerated, and kept at 0 degrees C overnight. A dilution series was prepared ranging from 9 down to 0.001 pairs of glands per 2 ml. distilled water. The series, together with two distilled water (unbuffered) controls, was bioassayed in the *Avena* test. The results are set out in Table 19. The

extract dilutions corresponding to 9 and 6 pairs of glands per 2 ml. distilled water caused a highly significant promotion of growth ($p < 0.01$), whereas the lowest dilution, 0.001 pairs of glands per 2 ml., showed significant inhibition of growth.

(c) Salivary glands from 10 females were crushed onto a small strip (approximately 1 x 2 cm.) of filter paper and eluted in distilled water at 25-26 degrees C. After 3 days, the extract was used to prepare a dilution series corresponding to 2, 1, 0.1, 0.01, 0.001 pairs of glands per 2 ml. distilled water. A fresh extract, similarly prepared, provided material for a parallel dilution series. The 3-day-old and fresh extracts were bioassayed in the *Avena* test, together with two untreated controls. Two days later, extracts of the two ages corresponding to 2 pairs of glands per 2 ml., were bioassayed in the *Avena* test. The results are presented in Table 20.

All dilutions of the freshly prepared extract show a very large promotion of growth. No difference can be detected in the growth of *Avena* sections floated in the various dilutions; i.e., there is no true dosage-response. Three of the dilutions of the 3-day-old extract show significant promotion of growth, but the amount of growth is small compared to that of sections floated in fresh extract. There appears to be no response to increased concentrations of the extract.

The fresh material kept for a further 2 days at 25-26 degrees C and bioassayed in the *Avena* test shows some loss of growth promoting value, although there is still a significant growth promotion. The 5-day-old material shows no growth promoting ability.

(d) Salivary glands of 15, 10, 5, and 1 females were separately crushed on small pieces (approximately 1 x 1 cm.) of filter paper, and eluted in 2 ml. 2% sucrose solution. These extracts, together with an untreated control (2 ml., 2% sucrose solution), were bioassayed in the *Avena* test. The results are presented in Table 21. The extracts of 15 and 10 pairs of glands both show growth promoting properties, but there is no response of the *Avena* mesocotyl sections to the extracts of 5 and 1 pairs of glands.

(e) Freshly dissected glands of two females were crushed onto a small piece of filter paper (1 x 1 cm.) and eluted in 2 ml. distilled water. A similar extract was made by elution of 2 pairs

of glands in 2 ml. 2% sucrose solution. The two extracts were assayed in the *Avena* test. The results, presented in Table 21, indicate promotion of growth in the distilled water extract, but none in the 2% sucrose solution extract.

(f) Freshly dissected salivary glands of male froghoppers were collected into acetone and macerated. The acetone was allowed to evaporate and the residue was taken up in (a) 2% sucrose solution (10 pairs of glands) and (b) distilled water (10 pairs of glands). Serial dilutions were made of each solution in the range 10 to 0.001 pairs of glands per 2 ml., and bioassayed in the *Avena* test. The results are presented in Table 22. In no case is there any evidence of promotion or inhibition of growth.

Summary and Discussion

The results of the experiments are interesting but inconclusive. There appears to be a growth stimulating factor in freshly prepared aqueous extracts of adult male and female salivary glands. The response of *Avena* mesocotyl sections to the salivary gland extracts has been consistent, although no dosage-response pattern has appeared. This may be due to variability of the experimental material. Salivary glands may contain larger amounts of saliva at one time than at another, possibly depending upon the age of the insect and the time since it last fed.

When the salivary glands are chromatographed in acetone: water, the growth promoting factor seems to be hidden or destroyed. Instead, a definite inhibition of growth is obtained at the solvent front (R_f 0.9-1). It is possible that two factors are present in the saliva of the froghopper, one which stimulates and one which inhibits growth. Or, there may be one substance, a growth-promoter, which gradually breaks down to become an inhibitor or toxin. Acetone might cause this breakdown.

However, it is not certain at present that a true growth promoter is present in the saliva. The active substance might be an enzyme that acts within the *Avena* tissues to liberate a "bound" endogenous growth promoter. Amylase, which breaks down starch to disaccharide sugars (sucrose), has been reported to occur in the saliva of several insects. Other enzymes may also be present, and together with amylase, may act to cause "blight." Additional studies on this interesting and important problem are projected.

Table 16

Bioassay of extracts from the salivary glands of adult froghoppers. Extracts prepared by chromatography in acetone: water (70:30)

Growth in mm. x 3 of 4 mm. sections of <i>Avena mesocotyl</i> :							
Material		12 Males		9 Females		10 Females	
Eluates from Rf.	0-0.1	14.3	(14-15)	14.1	(14-15)	—	—
	0.1-0.2	14.1	(14-15)	14.0	(—)	—	—
	0.2-0.3	14.0	(—)	14.2	(14-15)	—	—
	0.3-0.4	14.5	(14-16)	14.0	(—)	—	—
	0.4-0.5	14.0	(—)	14.1	(14-15)	—	—
	0.5-0.6	14.1	(14-15)	14.0	(—)	—	—
	0.6-0.7	14.6	(14-16)	14.3	(14-15)	—	—
	0.7-0.8	14.1	(14-15)	14.2	(14-15)	—	—
	0.8-0.9	14.2	(14-15)	14.3	(14-15)	—	—
	0.9-1.0	12.9*	(12-13)	12.8*	(12-13)	12.0* (11-13)	11.9* (11-12)
				1		14.0 (—)	14.0 (—)
				0.1		14.2 (14-15)	14.1 (14-15)
				0.01		14.1 (14-15)	
				0.001		14.0 (—)	
				0.0001		14.6 (14-16)	
Controls		14.2	(14-15)	14.1	(14-15)	14.0 (—)	13.7 (13-14)
						14.0 (—)	

(Figures in brackets indicate the range of response in 10 replicates)

* Highly significant inhibition ($p < 0.01$)

Table 17.

Bioassay of extracts from the salivary glands of adult froghoppers. Extracts prepared by chromatography in distilled water.

<i>Growth in mm. x 3 of 4 mm. sections of Avena mesocotyl:</i>	
Materials	(10 Females)
<i>Eluates from Rf:</i>	
0—0.1	14.1 (14—15)
0.1—0.2	14.0 (—)
0.2—0.3	14.0 (—)
0.3—0.4	14.0 (—)
0.4—0.5	14.0 (—)
0.5—0.6	14.0 (—)
0.6—0.7	14.0 (—)
0.7—0.8	14.0 (—)
0.8—0.9	14.2 (14—15)
0.9—1.0	14.0 (—)
Control	14.0

(Figures in brackets indicate range of response in 10 replicates).

Table 18

Bioassay of extracts from the salivary glands of adult froghoppers. Extracts prepared by macerating the glands in 2% sucrose solution

Growth in mm. x 3 of 4 mm. sections of <i>Avena mesocotyl.</i>					
Material	5 Males		2 Females		5 Males
Replicates (1)	27.2	(25-29)	25.2	(22-28)	15.5 (15-16)
(2)	25.2	(23-29)	27.1	(27-28)	17.6 (17-18)
Control	14.3 (14-15)				14.1 (14-15)

(Figures in brackets indicate range of response in 10 replicates).

Table 19

Bioassay of extracts from the salivary glands of adult froghoppers. Extracts prepared by macerating the glands in distilled water (unbuffered)

Growth in mm. x 3 of 4 mm. sections of <i>Avena mesocotyl.</i>			
Material	27 Males		
"Dosage" series	Replicates		
Pairs of glands	(1)	(2)	
9	15.5 (14-17)*	—	
6	15.7 (15-17)*	—	
4	14.7 (14-16)	—	
3.2	14.0 (-)	—	
1.6	14.2 (14-15)	—	
0.8	14.1 (14-15)	—	
0.4	14.4 (14-15)	—	
0.2	14.1 (13-15)	—	
0.1	13.9 (13-14)	13.9	(13-14)
0.01	14.2 (14-15)	14.1	(14-15)
0.001	13.4 (13-14)	13.2	(12-14)
Control	14.0 (13-15)	14.3	(14-15)

(Figures in brackets indicate range of response in 10 replicates).

* Highly significant growth promotion ($p < 0.01$)

Table 20.

Bioassay of extracts from salivary glands of adult froghoppers. Extracts prepared by crushing the glands onto filter paper and eluting in distilled water.

Growth in mm. x 3 of 4 mm. sections of <i>Avena mesocotyl</i> :		
Material	10 Females	10 Females
"Dosage" (Pairs of glands per 2 ml.)		
	<i>3-day-old extract</i>	<i>fresh extract</i>
2	13.6 (13—14)	21.6 (20—22)*
1	16.0 (15—17)*	22.2 (21—23)*
0.1	15.4 (15—16)*	22.0 (21—23)*
0.01	14.1 (14—15)	20.1 (19—21)*
0.001	15.5 (14—16)*	22.4 (21—24)*
Control	14.0 (—)	13.8 (13—14)
2	<i>5-day-old extract</i> 13.7 (13—14)	<i>2-day-old extract</i> 15.5 (15—16)

(Figures in brackets indicate range of response in 10 replicates).

* Highly significant promotion of growth ($p < 0.01$)

Table 21.

Bioassay of extracts from the salivary glands of adult froghoppers. Extracts prepared by crushing the glands on filter paper and eluting in 2% sucrose solution or in distilled water.

Growth in mm. x 3 of 4 mm. sections of <i>Avena mesocotyl</i> :		
Material	(15 + 10 + 5 + 1 + 2 + 2 Females)	
"Dosage" (pairs of glands per 2 ml.)		
(a) 2% sucrose solution		
15	16.4	(16—17)*
10	16.5	(16—17)*
5	14.5	(14—15)
1	14.3	(14—15)
2	14.0	(—)
(b) distilled water		
2	19.2	(18—20)*
Control	14.4	(14—15)

(Figures in brackets indicate range of response in 10 replicates).

* Highly significant promotion of growth ($p < 0.01$)

Table 22.

Bioassay of extracts of the salivary glands of adult froghoppers. Extracts prepared by macerating glands in acetone, evaporating to dryness, and taking up the residue in (a) 2% sucrose solution and (b) distilled water

<i>Growth in mm. x 3 of 4 mm. sections of Avena mesocotyl:</i>		
Material	10 Males	10 Males
"Dosage" (pairs of glands per 2 ml.)	(a) 2% Sucrose solution	(b) distilled water
10	14.0 (—)	14.0 (13—15)
1	14.0 (—)	14.2 (14—15)
0.1	14.5 (14—15)	14.0 (—)
0.01	14.3 (14—15)	14.0 (—)
0.001	14.7 (14—15)	14.0 (—)
<i>Control</i>		
(i) (acetone evaporated to dryness)	14.0 (—)	14.0 (—)
(ii) (untreated)	14.4 (14—15)	14.0 (—)

(Figures in brackets indicate range of response in 10 replicates).

F. Rearing froghoppers in captivity

Some progress has been made in the rearing of froghoppers in the insectary. The insects were reared on the roots of young sugar cane plants grown from one and two eyed pieces planted upright in large flower pots. Newly hatched nymphs from eggs kept on moist filter paper in petri dishes were transferred to the roots of the pot grown plants, and several completed development to the adult stage. In other cases, eggs laid in moist blotting paper by adults kept in captivity were "planted" in the soil near to plotted cane plants. Some nymphs hatching from these eggs were able to find their way to suitable roots, and to complete development to the adult stage.

In all cases where nymphs were known to be present, the young cane plants showed symptoms of damage similar to that observed by Wilson *et. al.* (1961) in pangola grass infested by froghoppers. The leaves became chlorotic, first the tips and later the entire leaf blade. In most cases the infested plant was stunted and eventually died. This presents a serious limitation to the method of rearing as the plants may die before the development of the nymphs is complete. A culture of as few as 10-15 froghopper nymphs per plant seems to cause severe damage. It is fortunate that in the field froghoppers do not usually attack sugar cane at such an early stage in plant development.

G. The composition of froghopper spittle

D. W. Fewkes and J. Smit

There has been considerable controversy about the nature and composition of Cercopid spittle since Sulc (1911) described the method of spittle production and surmised that the froth was a soap-like substance. A recent paper by Ziegler and Ziegler (1958) is of considerable interest. This paper was translated from the original German by Mr. J. Smit, and the translated "Summary of Results" is given below.

1. The substance that enables nymphs of

Philaenus spumarius L. and *Aphrophora salicis* de G. to produce spittle by excretion is a protein; it contributes about 90% of the total amount of organic matter in the froth. The presence of a soap like substance to a noteworthy amount is out of the question whereas sugar has not been found neither in a free form nor as a polysaccharide.

2. The amino acids content of the hydrolysate of spittle protein is specific for the species, and is not related to the nature of the host plant: we are dealing with a product of animal metabolism.
3. Tested excreta did not contain nitrogen as a part of inorganic compounds or uric acid. The quantitative fraction of the ash constituent of *Philaenus*-spittle is of the same order of magnitude as the one given by Gruner for *Aphrophora*-excreta.
4. The possibilities of an excretion of substances with a high N/C ratio by plant sucking insects are discussed.

Work at Imperial College, London, by Howden and Marshall (1960, personal communication) suggested that the spittle stabilising agent of another spittle bug, *Philaenus spumarius* L. was a mucopolysaccharide, not a protein.

Wilson and Dorsey (1957) found both amino acids and sugars in spittle of *Philaenus leucopthalmus* (L.) and *Aphrophora parallela* (Say.) on alfalfa and Scotch pine, but neither on spittle from red clover and red pine. Hydrolysis of the spittle indicated the presence of a protein in all cases, and of a polysaccharide in spittle from alfalfa, red pine and Scotch pine, but not from red clover.

Kershaw (1913) working with the sugar cane froghopper (*Aeneolamia varia saccharina* Distant), suggested that the spittle was a mucinoid. He found no evidence of protein, but detected crystals of calcium oxalate and uric acid.

The conflicting results of the various investigators are summarised below.

Authors	GRUNER (1901)	KERSHAW (1913)	WILSON & DORSEY (1957)	ZIEGLER & ZIEGLER (1958)	HOWDEN & MARSHALL (1960)
Insects	<i>Aphrophora</i> sp.	<i>Aeneolamia</i> <i>varia</i> <i>saccharina</i> Distant.	<i>Philaenus</i> <i>leucoptthalmus</i> (L.). <i>Aphrophora</i> <i>parallela</i> (Say).	<i>Philaenus</i> <i>spumarius</i> L. <i>Aphrophora</i> <i>salicis</i> de G.	<i>Philaenus</i> <i>spumarius</i> L. <i>Neophilaenus</i> sp.
Sugars	(Nil)	—	(a)* Yes	(b)* (Nil)	(c)* (Nil)
Poly saccharide	—	—	Yes	Yes	(Nil)
Amino- Acids	—	—	Yes	(Nil)	(Nil)
Proteins	—	(Nil)	Yes	Yes	Yes
Uric Acid	—	Yes	—	—	(Nil)

* (a) Spittle from alfalfa and Scotch pine

(b) Spittle from red pine

(c) Spittle from red clover

Fundamental studies of this nature are important as the results may have practical applications (eg. Methods of dissolving spittle to afford better control of nymphs with or without insecticides).

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IV. SOIL MICROBIOLOGY

J. W. Brough

The rhizosphere of sugar cane, as far as we are aware, has never been studied in detail. A required pre-requisite to such a study is the quantitative estimation of the fluctuations in populations of soil bacteria, fungi, and streptomycetes, occurring at given intervals throughout the year. During 1962 a quantitative study of the microflora was completed in a heavy clay (Frederick very heavy clay), a clay loam (Waterloo loam and clay), and a sandy loam (McBean sand and loam). Bacteria, fungi, and streptomycetes were isolated at weekly intervals, following the procedures described in the C.A.R.S. Annual Report for 1960—1961.

Frederick very heavy clay is characterized by impeded drainage, while Waterloo loam and clay often shows imperfect drainage. McBean sand and loam drains freely. It was suspected that these characteristic differences in drainage might influence fluctuations in the total population micro-organisms in the three different types of soil, particularly during the rainy season. Therefore, soil moistures were taken at weekly intervals, coinciding with the collection of soil samples for microbial analyses.

1. *Frederick Very Heavy Clay*

The fluctuations in numbers of bacteria, fungi, and streptomycetes occurring in Frederick very heavy clay throughout the year are reflected in Table 1 and in Figure 1. There were three distinct peaks in the population. The numbers of micro-organisms in this very heavy clay soil appeared to be directly related to the moisture content of the soil (Figure 1). "Peak 1" is considered to be due to the increase in population brought on after the onset of the first rains, following an extended dry season. The samples of soil collected and analyzed at this period probably contained a "resting" population. The increase in numbers of microbes continued for a period of about ten weeks, tending to fall off as the soil became saturated. A second peak occurred after the soil had been saturated for a number of weeks and could possibly have resulted from the influence of actively growing surface roots of cane into the area which was

sampled. The third and most pronounced increase in the total microbial population came at a time when soil moistures were decreasing.

Future rhizosphere studies in Frederick very heavy clay will have to take into account the marked influence of rainfall and soil moisture on the quantitative aspect of microbial flora. Of particular interest is the fact that the microbial population increased in a water-saturated soil ("peak 2"). It may well be that interactions between the root system and the microbes were operating under such conditions.

2. *Waterloo Loam and Clay*

As in the case of Frederick very heavy clay, there was a sharp rise in the total microbial population with the onset of the rainy season (Figure 2, Table 2). A steady rise in population was noted ("peak 3", Figure 2) as the percentage of moisture in the soil decreased. "Peaks 2 and 3" (Figure 2) occurred when there was a slight depression in the moisture content of the soil. During the rainy season, the plots from which the soils were collected were water-saturated almost continuously, excepting for occasional decreases in moisture. These occasional depressions in total moisture were accompanied by increases in microbial numbers.

3. *McBean Sand and Loam*

Increases in microbial numbers in McBean sand and loam also coincided with the onset of heavy rains (Figure 3, Table 3). "Peak -2" occurred just prior to saturation and was followed by a sharp drop in microbial activity as the soil became saturated. Saturation in this lighter soil takes place much more slowly than in the heavier clays and, therefore, there was more of a delay in the build-up of the total microbial population than had been noted in Frederick very heavy clay or in Waterloo loam and clay. Conversely, the more rapid drying of the sandy soil accounted for more abrupt depressions in microbial numbers than in Frederick very heavy clay or Waterloo loam and clay.

The results of the microbial survey point to a significant influence of soil moisture upon the total population. It may be inferred from the results that the water-holding capacity of the soil determines to some extent the rapidity with which the microbial flora increases or decreases in a given type of soil. In the heavier clays and clay-loams the population increases sharply with the onset of the rainy season (following a prolonged dry season), but microbial numbers fall off sharply as the soil is saturated. In lighter soils (i.e. McBean sand and loam), which have a much lower water-holding capacity than the heavier clays, there appears to be a much slower increase in microbial numbers following the onset of the rainy season. The slower rate of water saturation in McBean sand and loam

is reflected in a slower rate of decrease in microbial numbers during the rainy season. The converse holds for Frederick very heavy clay and Waterloo loam and clay. Quite likely microbial activity in the vicinity of sugar cane roots influences the metabolism of the plant. One may expect to find differences between the rates of root growth influenced not only by the type of soil but also by the direct effect of microbial exudates. Now that the quantitative aspects of the study have been completed, we are planning to attack the problem from a qualitative standpoint. Of particular value would be information on the role of microbial exudates on the growth of the root system and conversely the influence of root exudates on the microbial population.

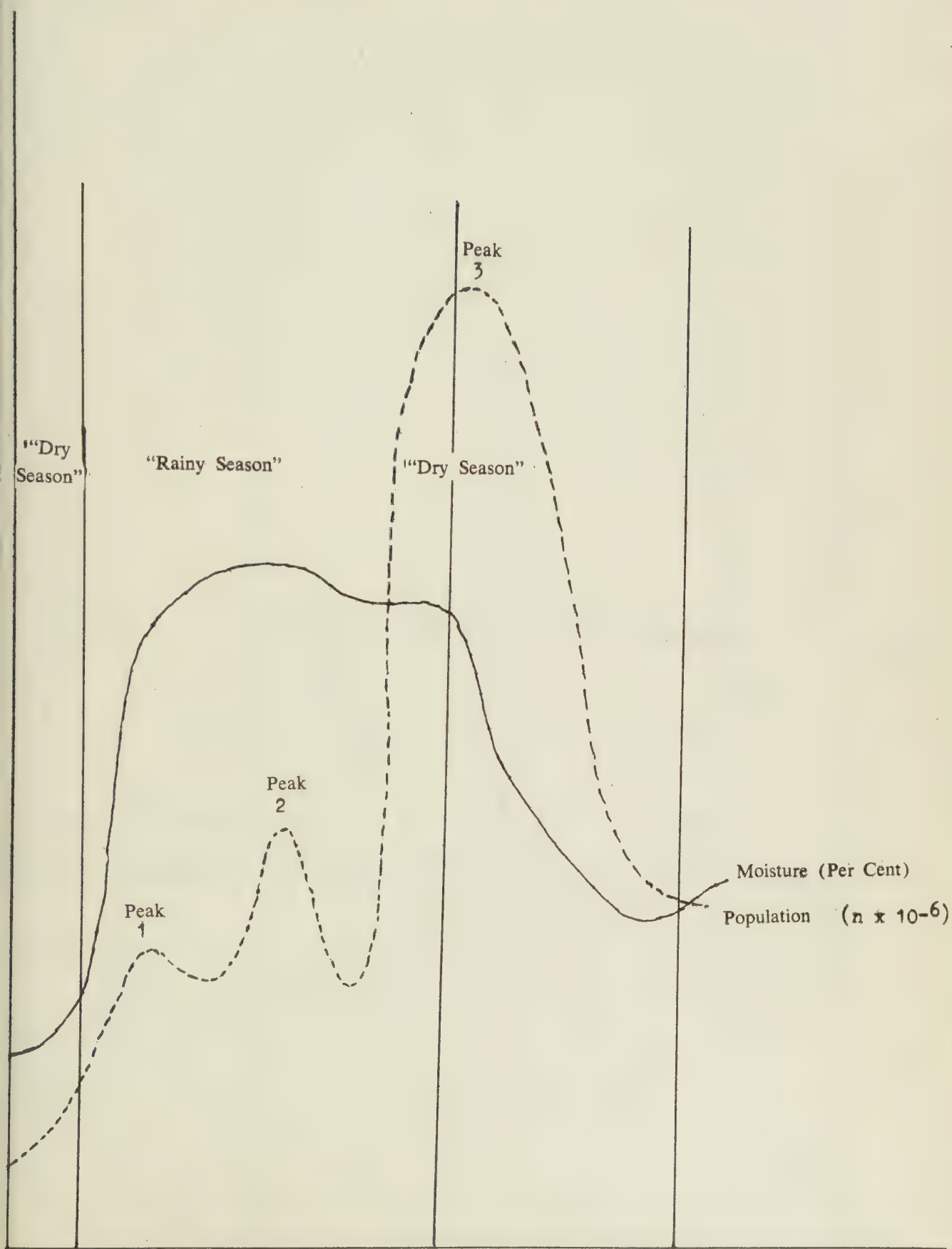


Figure 1. Fluctuations in total microbial population in Frederick very heavy clay as related to changes in soil moisture.

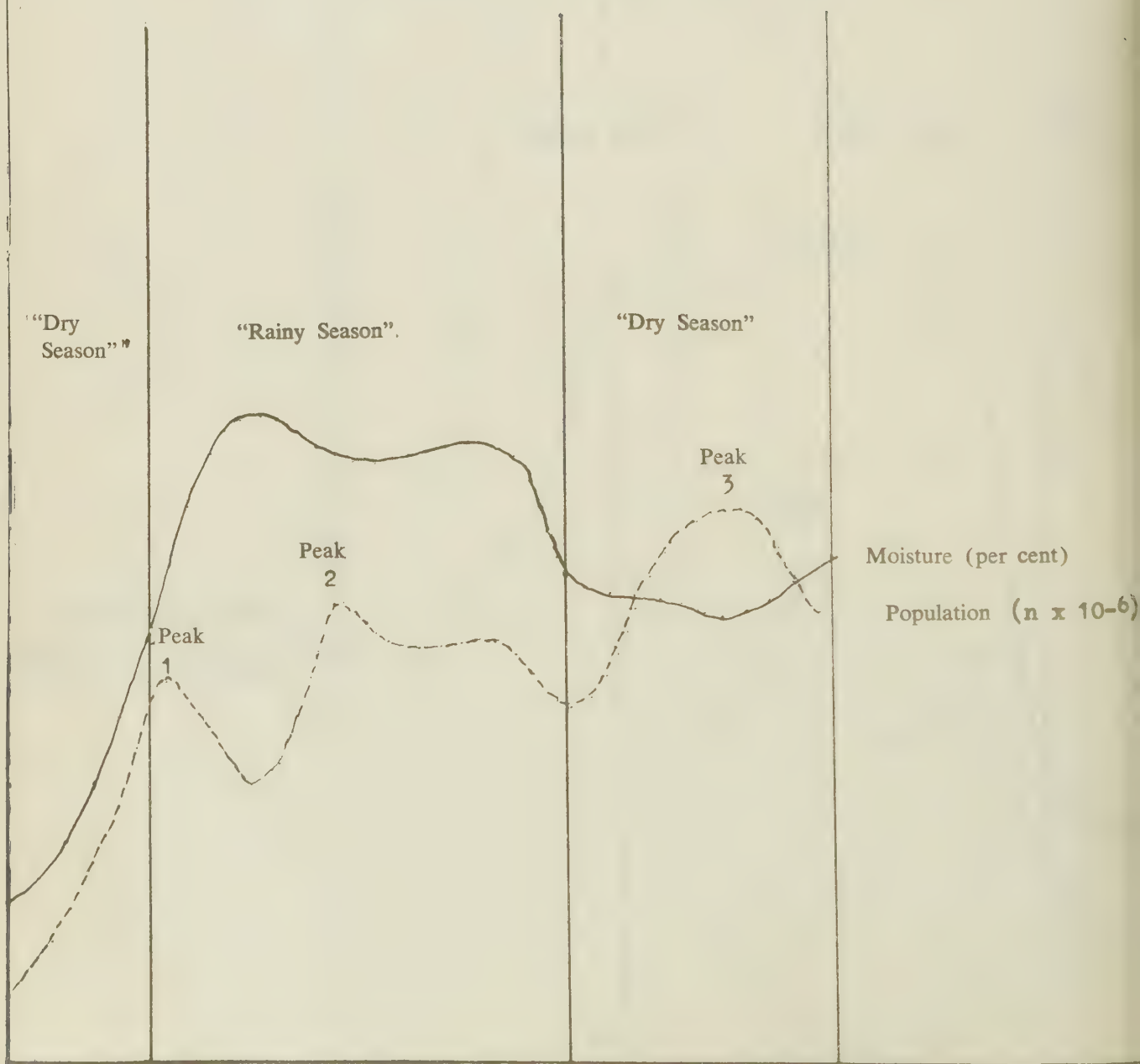


Figure 2. Fluctuations in total microbial population in Waterloo loam and clay as related to changes in soil moisture.

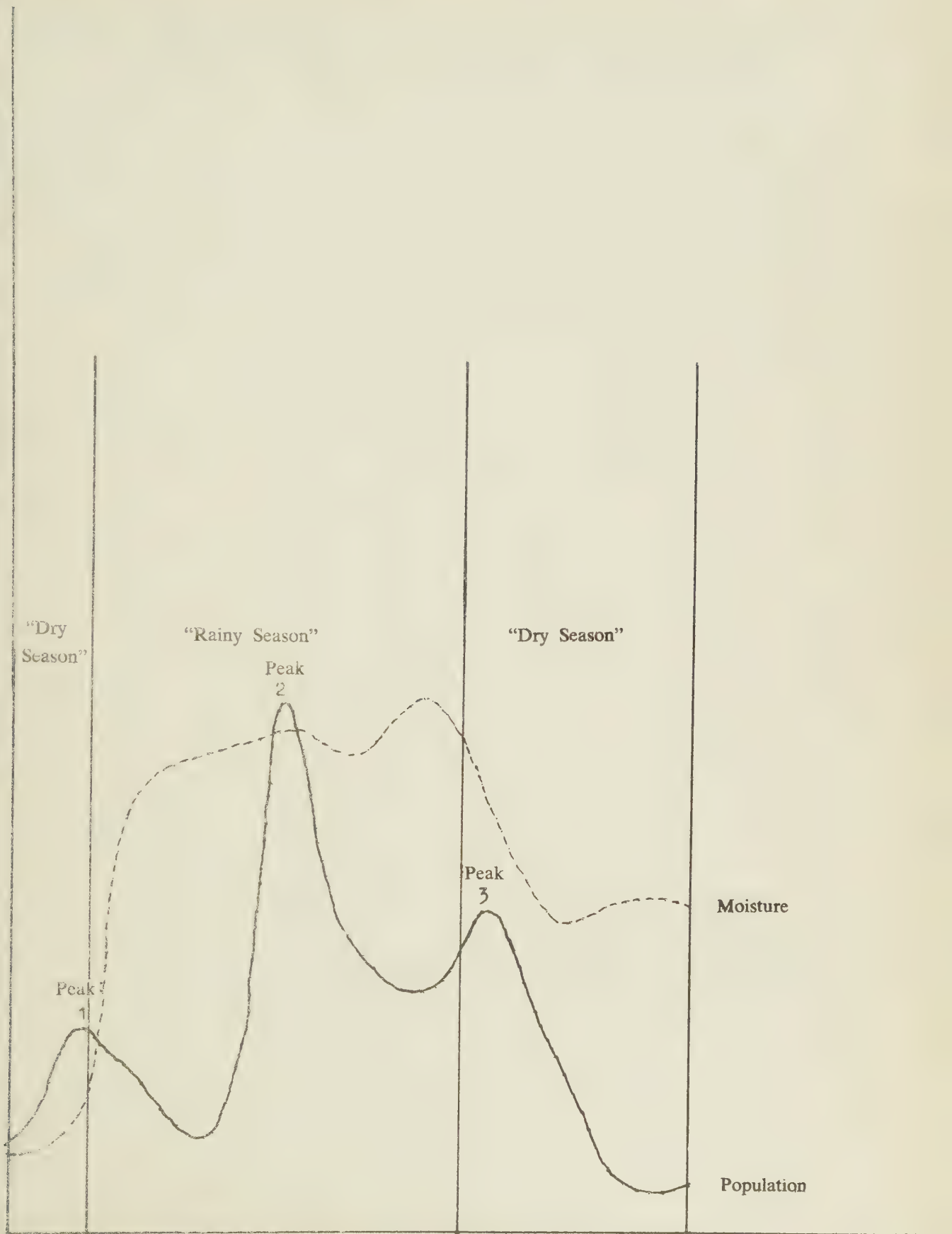
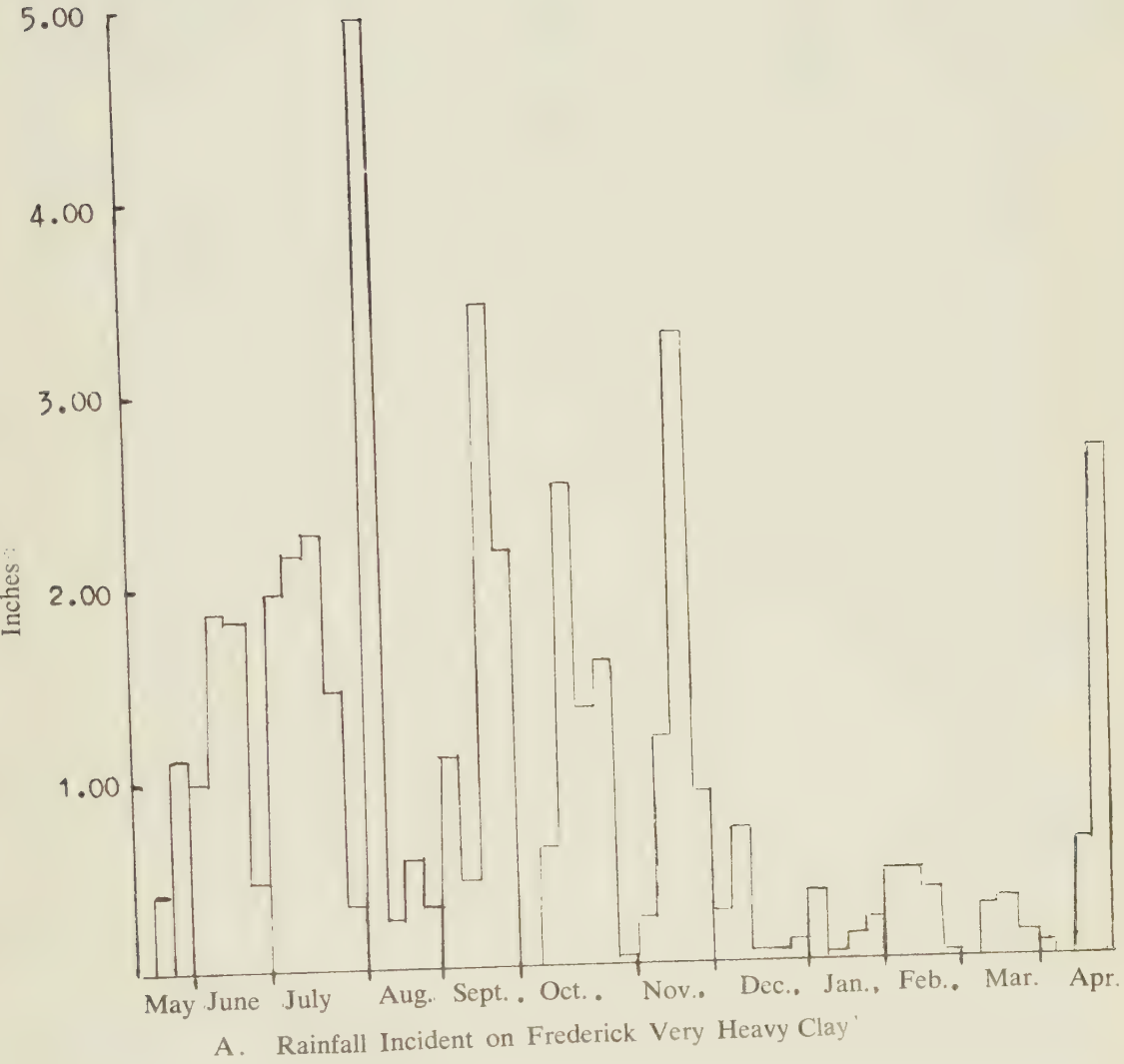


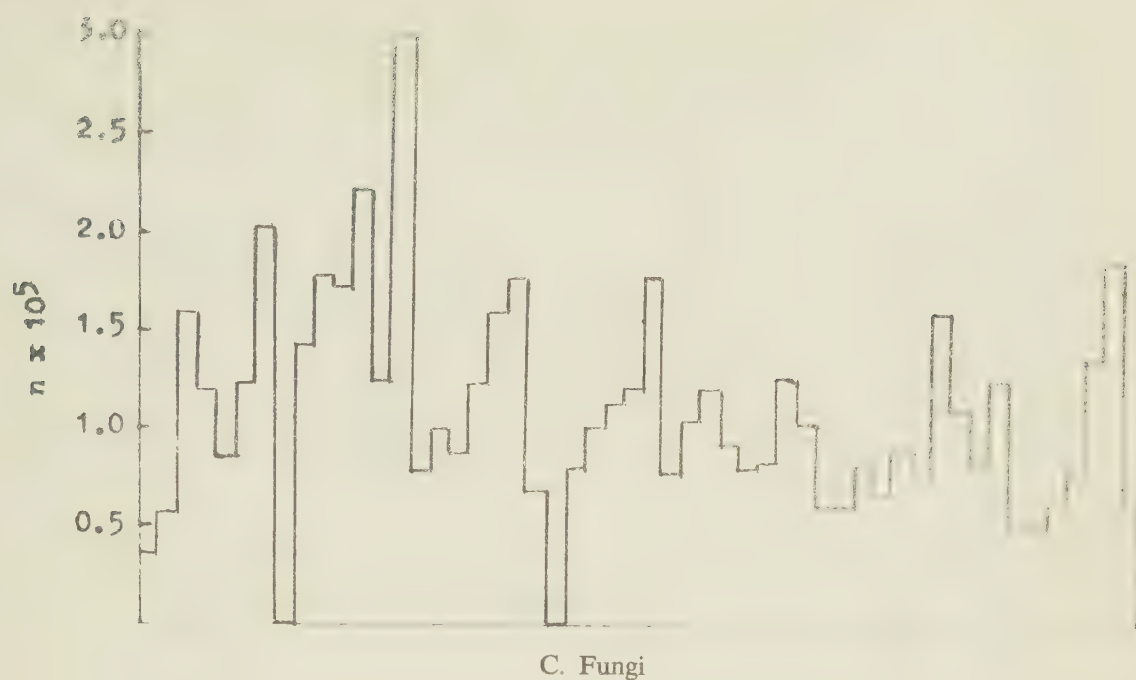
Figure 3. Fluctuations in total microbial population in McBean sand and loam as related to changes in soil moisture.

TABLE 1. Populations of Fungi (C), Bacteria (D), and Streptomycetes (E) in Frederick very heavy clay as related to Rainfall (A), and Soil Moisture (B).



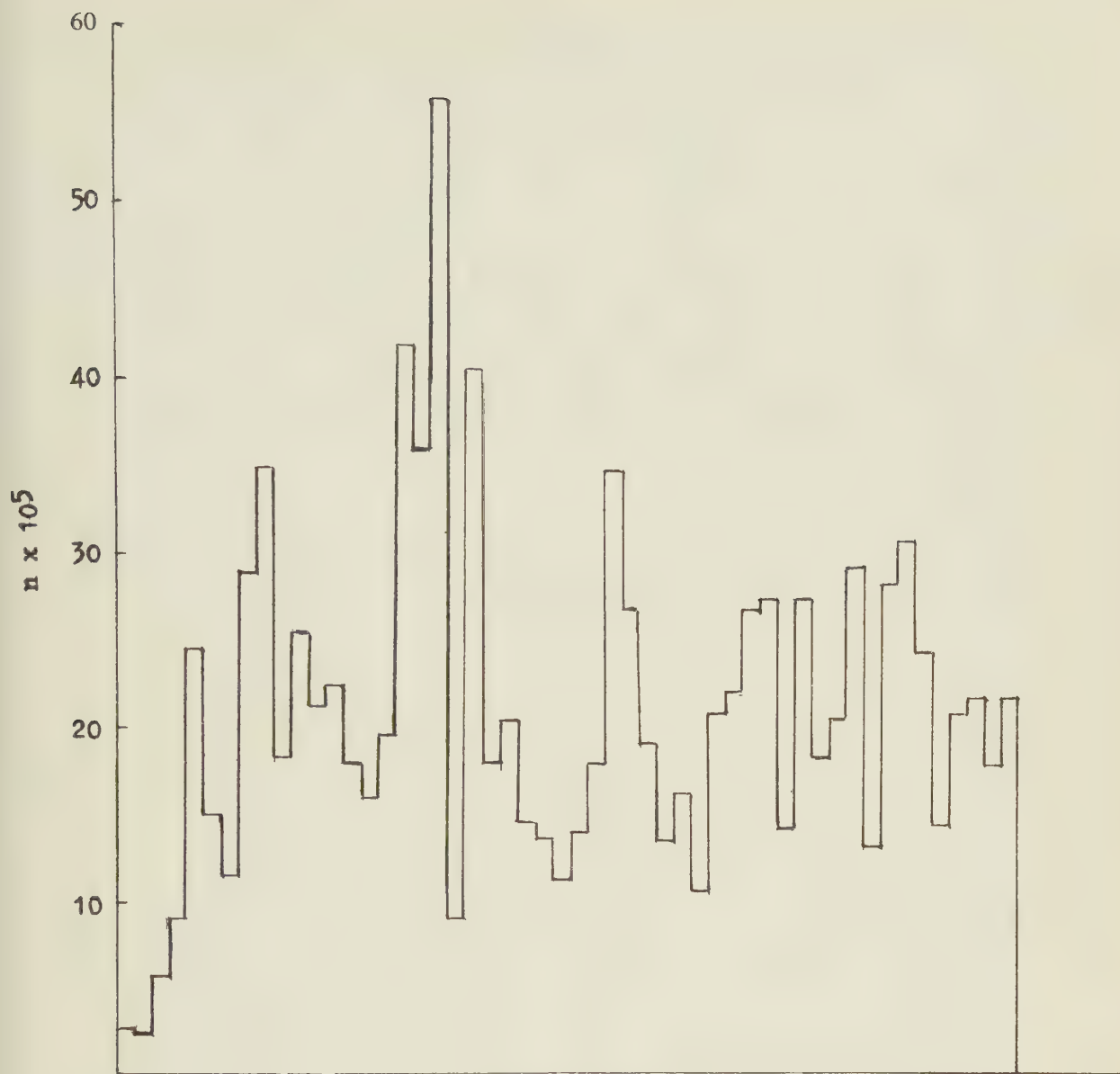


B. Soil Moisture (per cent)

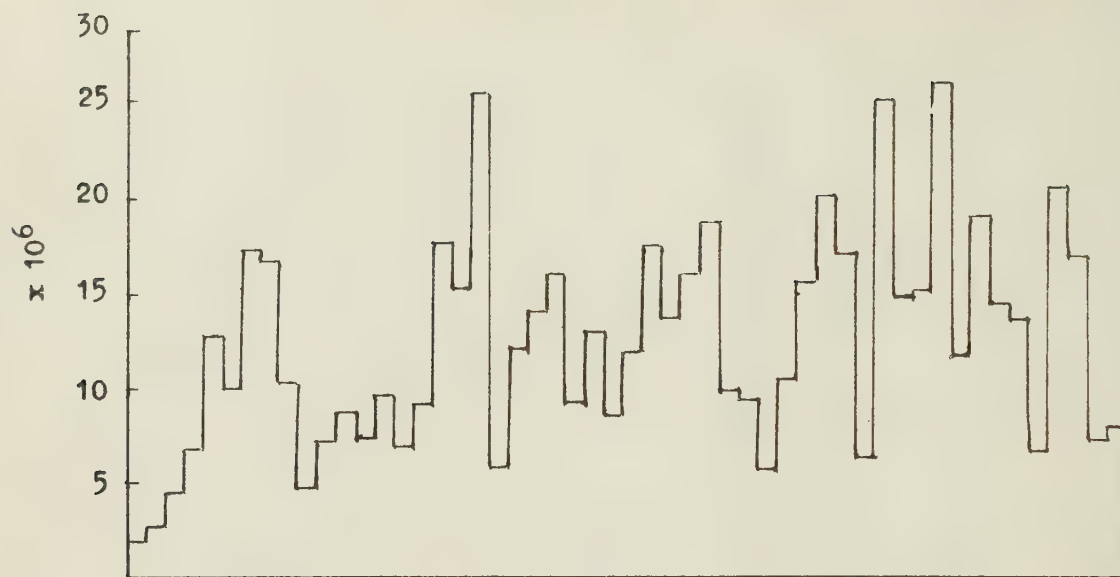




D. Bacteria

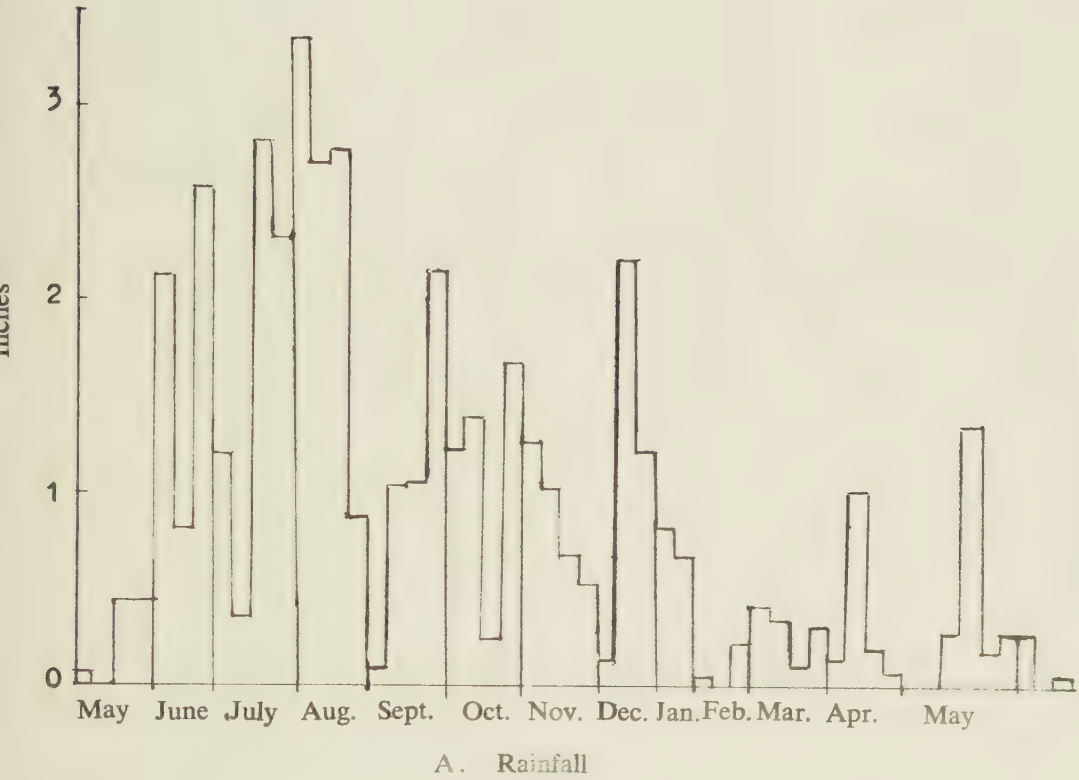


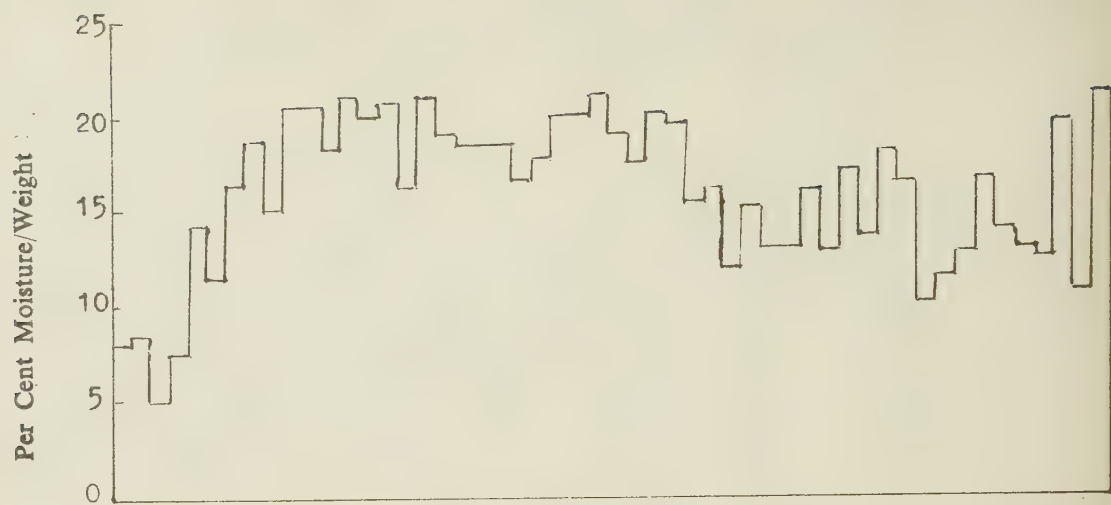
E. Streptomyces



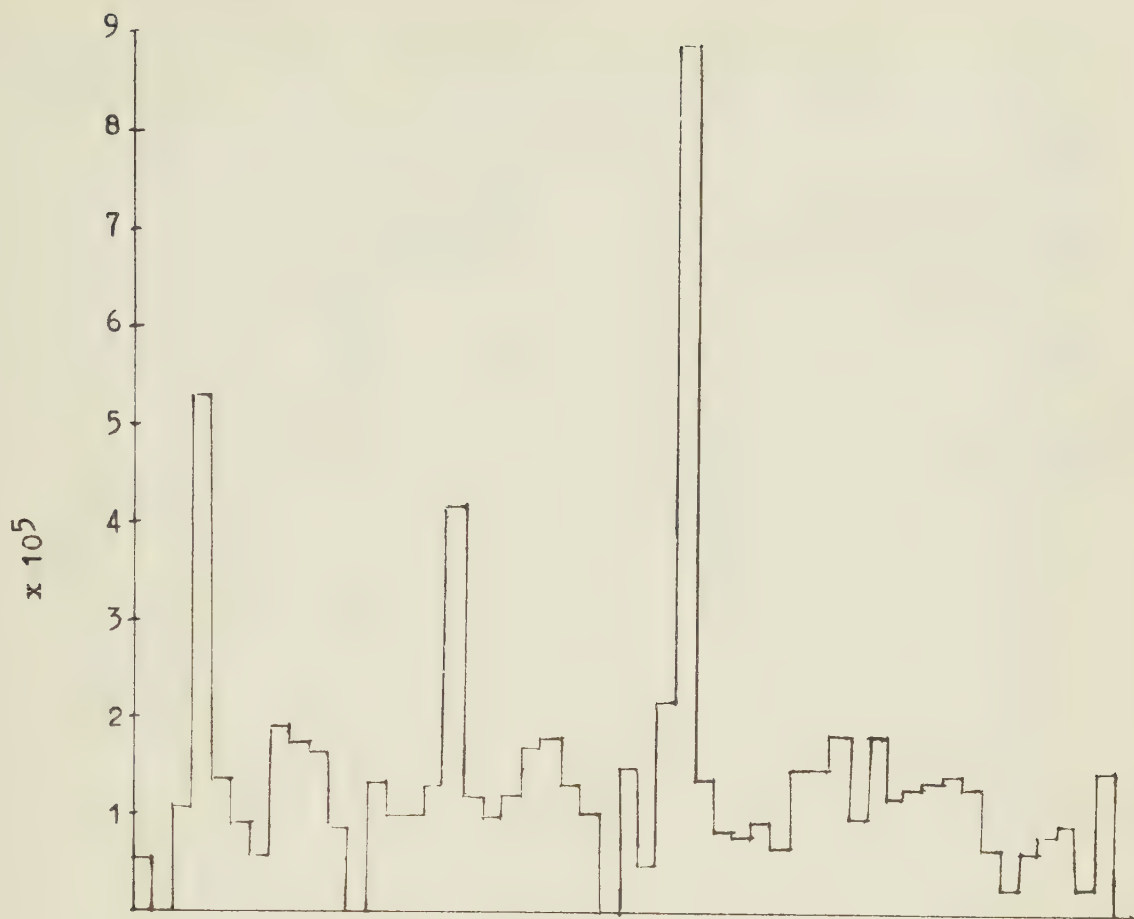
F. "Total" Population

TABLE 2. Populations of Fungi (C), Bacteria (D), and Streptomyces (E) in Waterloo loam and clay as related to Rainfall (A), and Soil Moisture (B).

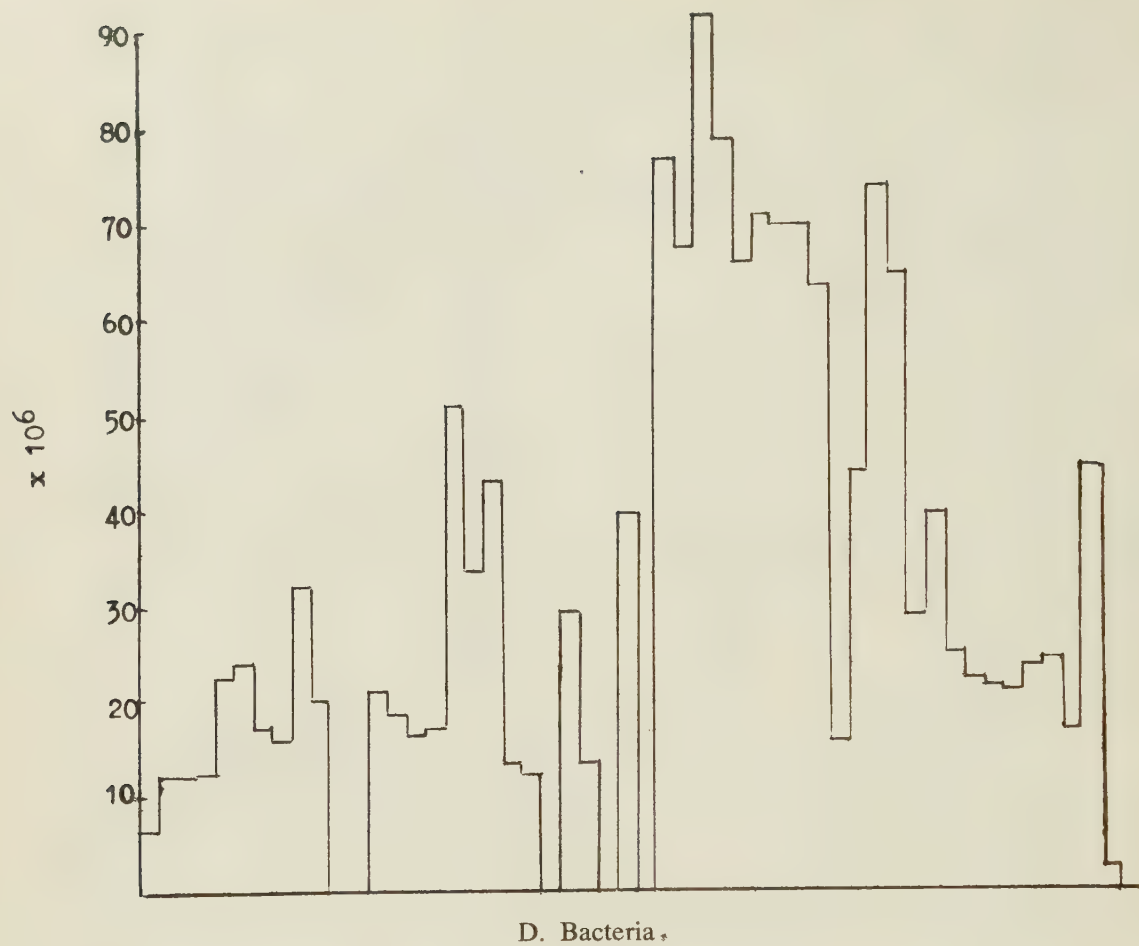


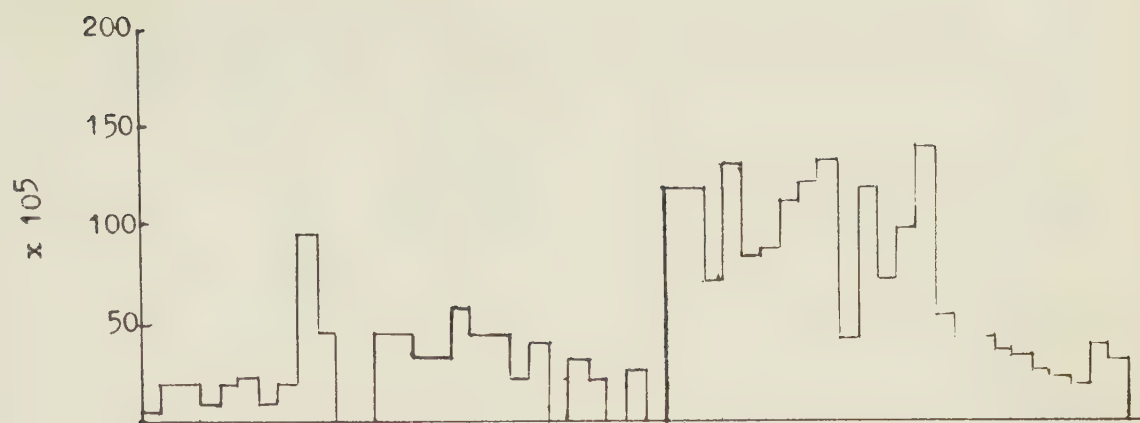


B. Soil Moisture .



C. Fungi





E. Streptomyces

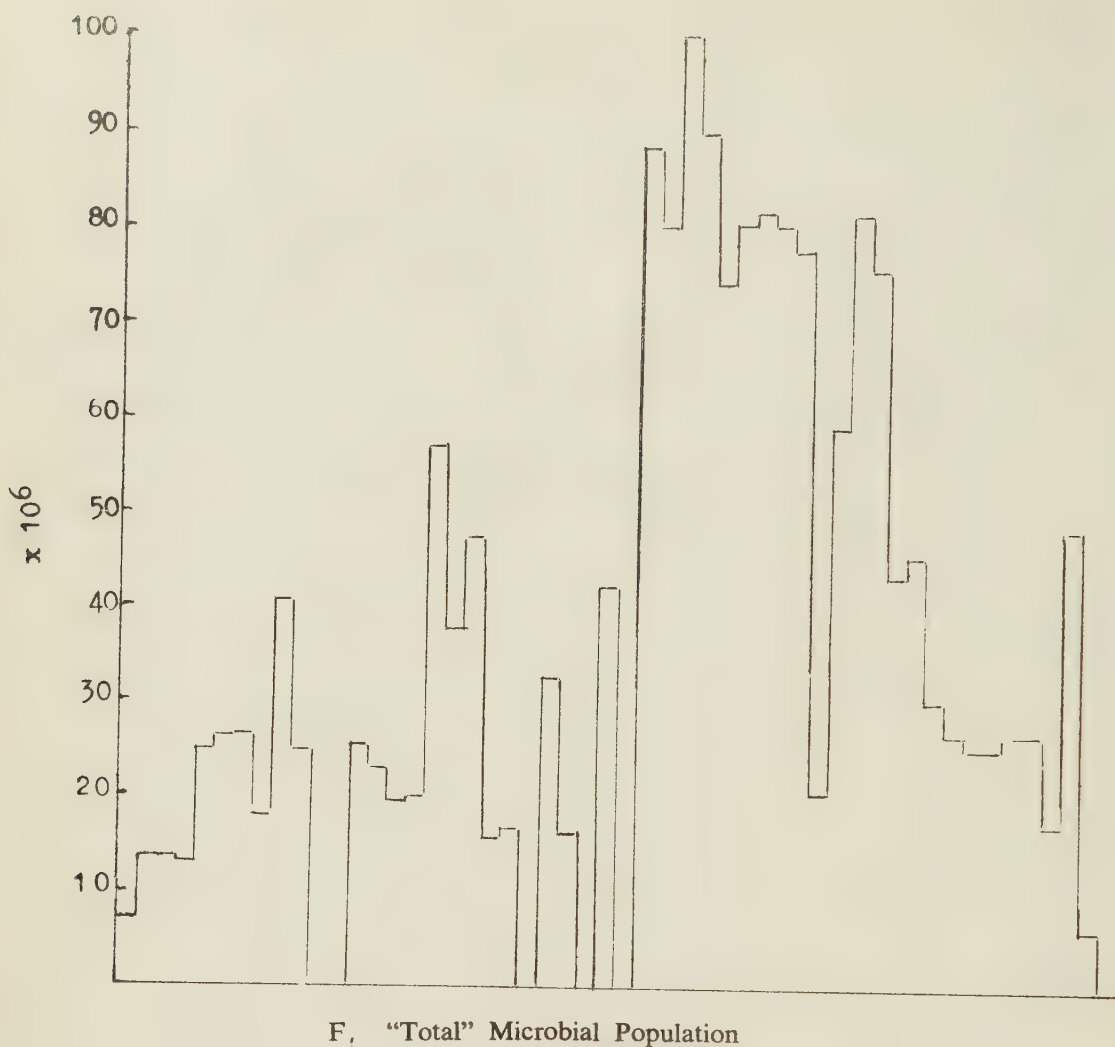
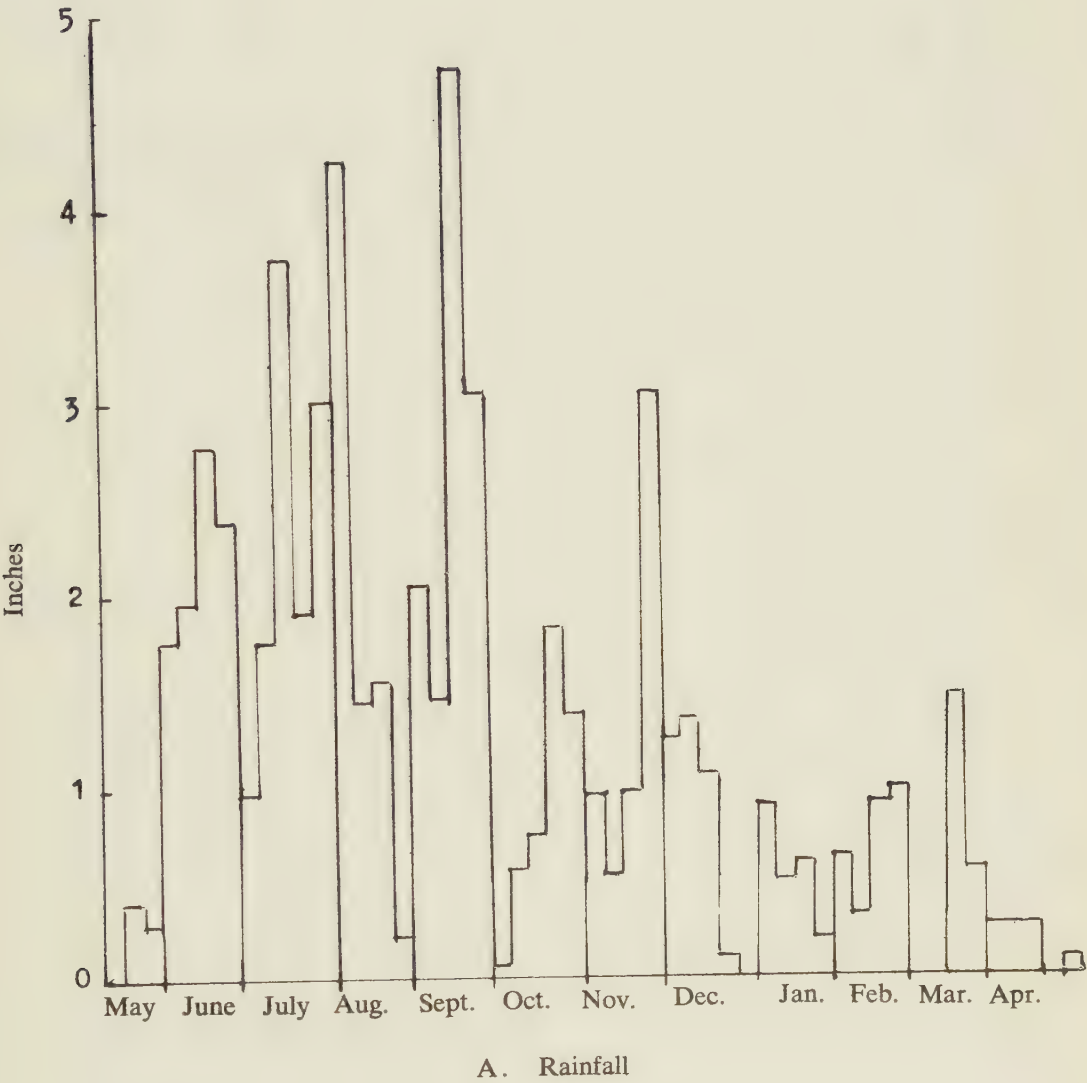
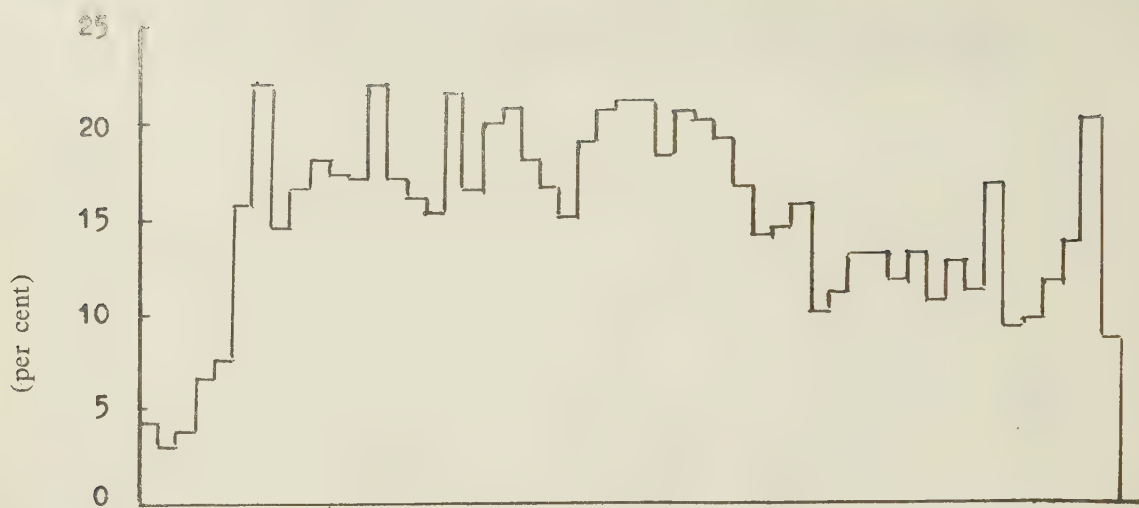
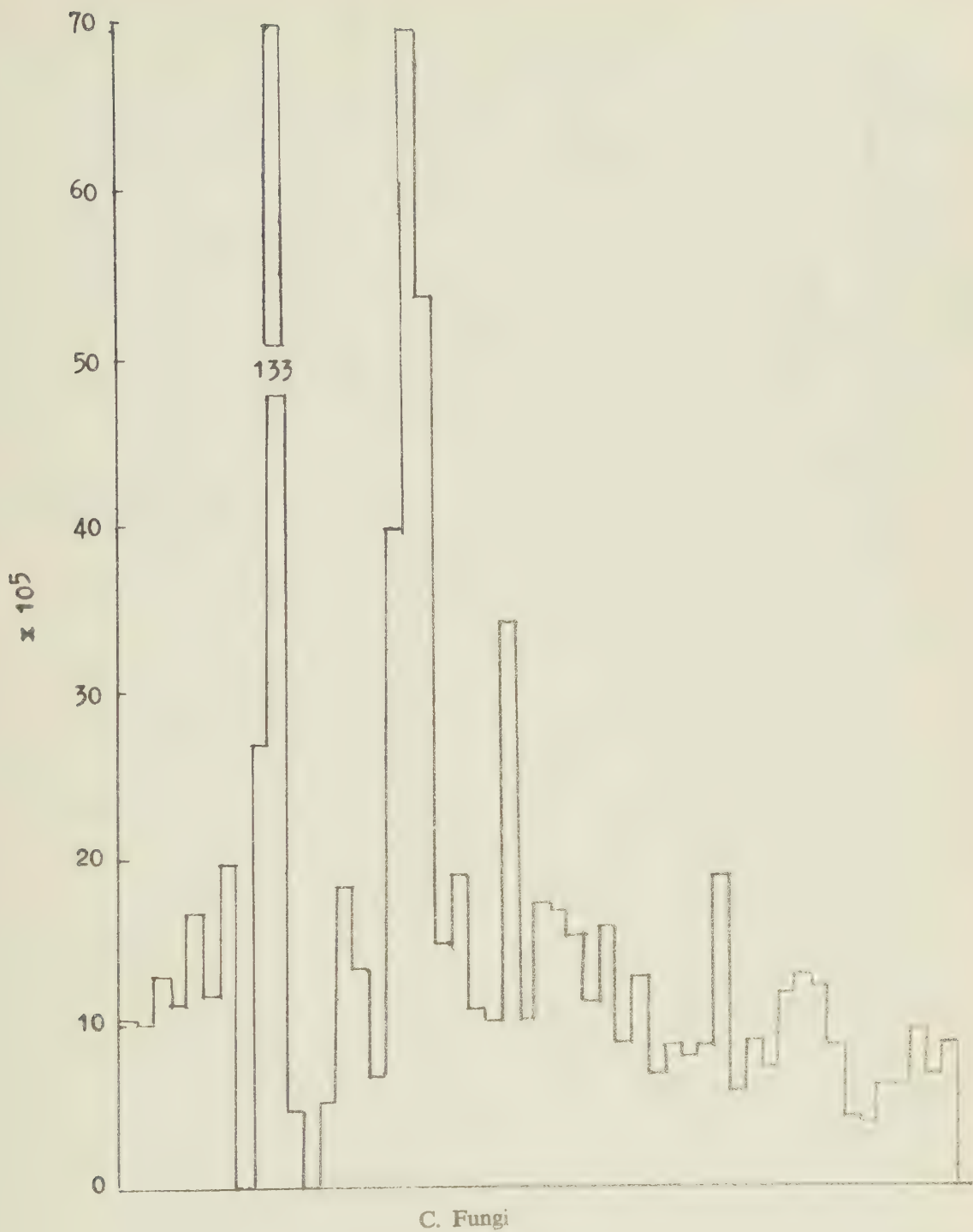


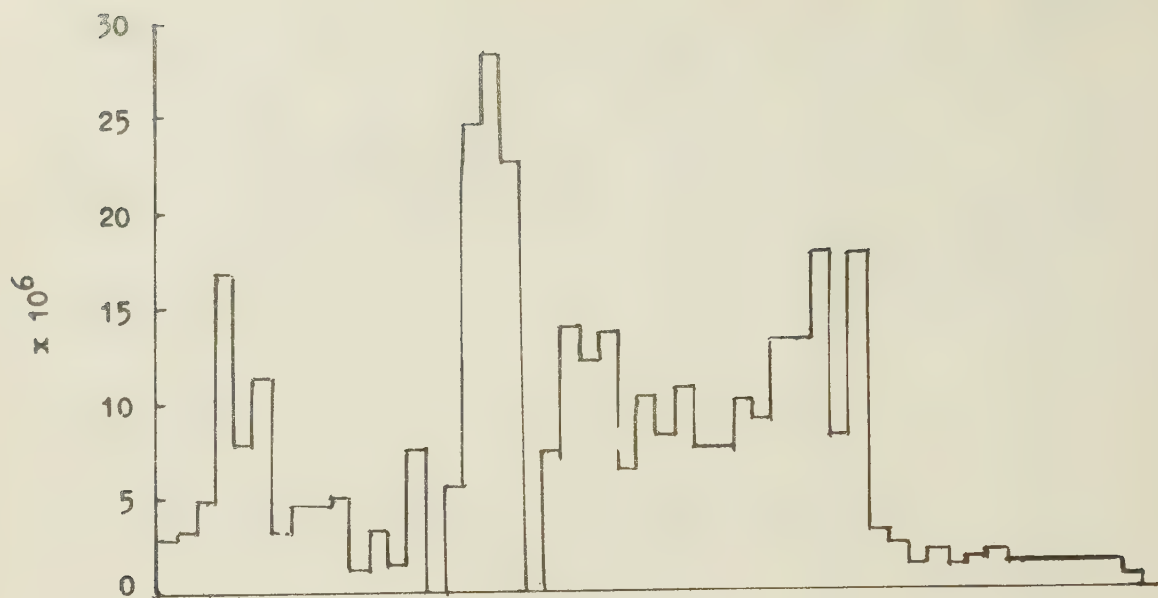
TABLE 3. Populations of Fungi (C), Bacteria (D), and Streptomyces (E) in Mc Bear sand and loam as related to Rainfall (A) and Soil Moisture (B).



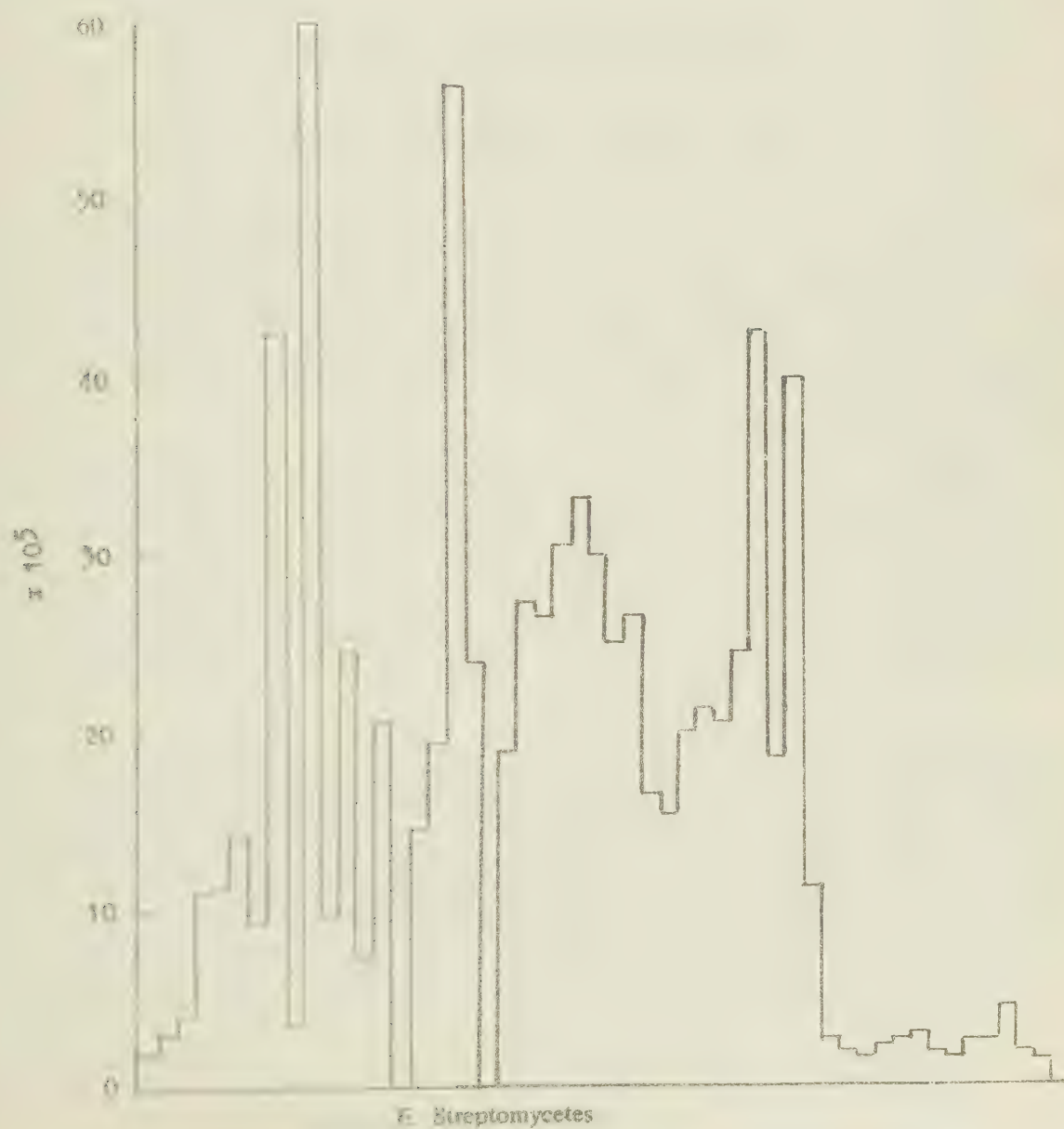


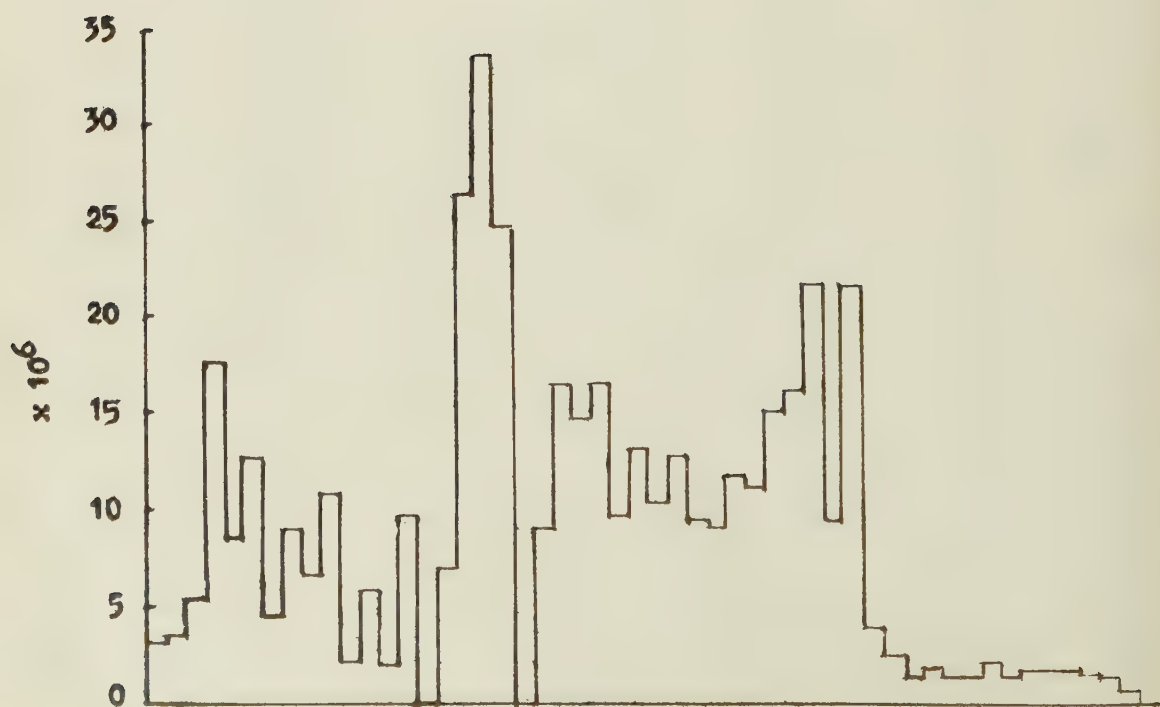
B. Soil Moisture





D. Bacteria .





F. "Total" Microbial Population

V. CLIMATOLOGY

A weather station is now in operation at C.A.R.S. Daily records are being kept of maximum-minimum temperatures, relative humidity, wind velocity, and intensity and duration of sunshine. Evaporation rates will also be determined and recorded in the near future. It is also planned that a recording pyrheliometer will be installed to record the levels of solar radiation throughout the year. All of this information will be made available to the Estates, and should prove of

value in assessing the role of environment on future yields.

Mr. G. W. Smith of the U.W.I., who assisted us considerably in establishing the weather station, has kindly provided a short article entitled: "*What's the Good of Recording the Weather?*" The paper is reproduced in its entirety below:

What's the Good of Recording the Weather?

by G. W. Smith

REGIONAL RESEARCH CENTRE, U.W.I.-
I.C.T.A., ST. AUGUSTINE

There is nothing so fundamental in agriculture as the weather. Unless there is rain, unless there is sun, unless the temperature lies between certain limits, unless the wind is moderate, crops will die. The weather enters into every single process in agriculture, from the formation of the soil to the consumption of the end product.

But the weather can influence plant life in more subtle ways. A high humidity will encourage the growth of fungi, viruses, and other disease-carrying organisms. Strong winds can cause tremendous damage to crops. Spraying and dusting with insecticides can be quite useless, possibly even dangerous, unless wind conditions are favourable. Soil moisture, which is controlled by the rainfall, may have unknown but significant effects on the biology of soil organisms.

From this it follows that measurements should be made of the weather, in any kind of agricultural research. The simplest type of climatological station has only a rain gauge and an observer to read it. The rain gauge may be very simple, though it should be of standard size, and be carefully exposed for worthwhile results. On the other hand, a well equipped station conducting fundamental research may have dozens of instruments, and its staff may be very large indeed.

WHAT MAKES A GOOD STATION?

The one man and his simple rain gauge can get results which may be as valuable as the elaborate organisation, though they may not be so extensive. It all depends on the man. If he is keen, if he takes the readings day in, day out, always at the same time, and always with accuracy, he will eventually build up a comprehensive collection of rainfall data which can be of the utmost value. Inaccurate readings are worse than useless. They may be completely misleading. So are irregular readings. One station in Trinidad always seemed to have a much lower rainfall than a neighbouring station. After much enquiring, it was discovered that the police (who ran the station) were taking the rain gauge inside the building at night to prevent its being stolen!

There is little point in collecting data, however good, if it is simply put on the shelf to collect dust. It must be properly analysed. From the field notebooks, the data should be transferred each day onto printed forms. Each month, means and totals should be computed. There is very little reliable data in tropical countries, so that it is worthwhile to share what there is. The central collecting agency is the West Indies Meteorological Service, with headquarters in Port-of-Spain, who always will be pleased to have reliable data.

WHAT SORT OF RESULTS CAN BE HOPED FOR?

This is a difficult question to answer. It all depends on what you are looking for. And it depends on what are your resources in equipment and man-power. Suppose, for instance, that you are interested in irrigation. If water is to be used efficiently, one of the problems is to know exactly how much water is in the soil at any time.

I have tried to show (1) that it is possible to do this, in certain cases, using only climatological records, together with certain soil constants.

This sort of technique may be useful in other fields. For instance, Brough (2) has shown that there is a relation between rainfall and microbial activity in some Trinidad sugar-cane soils. The correlation may be closer if soil moisture instead of rainfall is used. The method that I have used may well be of value in this case. Indeed, it (or a similar method) is the only way I know for estimating soil moisture retrospectively. Provided that the rainfall data is available, then it is easy to obtain the soil moisture figures.

On the other hand, you might be interested in introducing a new kind of crop into your area. This might perhaps be potatoes. Since these are usually grown in temperate climates, an obvious climatological element to measure would be soil temperature in the rooting zone. Another would be length of day.

Again, suppose that you are trying to find what is the best time to deal with a pest such as frog hopper. If you wait until the damage to the cane has already appeared, it may be too late to take action. But if you have carried out a series of observations of insect activity, you may have been able to correlate this with some climatological factor such as humidity, maximum or minimum temperature, etc. The chances are that you will be able to predict such activity before it happens, merely by looking for the appropriate weather conditions.

As an example of this sort of result, a great many observations have shown that locust swarms tend to move down-wind, towards zones with convergent wind-flow. Such conditions are also necessary for the production of rainfall. It is

known that this rainfall is needed to provide a suitable environment for the locusts' breeding.

So that it is possible to predict the breeding places of the locusts by noting where conditions are most favourable for rain. This is done with the normal weather charts, and control measures are taken in time. Even if this method prevents only one locust attack in a year, it will have been worthwhile. Outbreaks in Morocco in 1954 and in Ethiopia, in 1958, each caused more than \$10 million (U.S.) worth of damage.

WHAT SHOULD BE DONE NOW?

When the C.A.R.S. climatological station is fully operational, its first task might be to collect as much data as possible with the instruments available, and to ensure that these results are properly analysed. Copies of all the records should be sent to the West Indies Meteorological Service, so that they are available to everyone who is interested.

In addition, other related measurements might be made, such as weekly auger samplings for soil moisture. These should preferably be taken under a permanent grass cover. Similar measurements might also be made under cane. It would be interesting to make micro-climatological readings in the cane. Remote-reading instruments, connected electrically with a central recording system, would be useful for measuring air and plant temperatures, humidity, air movement horizontally or vertically, etc. This work would be valuable in frog hopper research.

As a further suggestion, "Crop Calendars" might be devised for cane. I have included such a calendar for rice, as used by the Indian Government. Observations have shown that rice can be best grown and harvested when certain climatological conditions occur. For instance, during the growing season, rain in excess of one inch per day is too heavy and tends to cause damage. When the crop is being harvested, any rain at all is likely to interfere. When such conditions occur, or are likely to occur, warnings are issued.

Under the heading "Normal Weather Requirements", these factors are given. During August, for instance, 3 to 6 inches of rain should be spread over 10 days, and during the "Harvest and Threshing" period in January and February there should be no rain at all. How

far conditions in an "Average" year meet these requirements is shown in the same section. In August, the average rainfall is 3.84 inches, spread over 5.5 days, so that although there is usually *enough* rain, it tends to fall in too short a period. This type of weather service is beginning to be of increasing value to agriculture, and it might well be worth trying, in a modified form, on sugar estates in Trinidad.

Above all, whatever you do, don't collect records without making use of them. It is a sheer waste of money, time, and effort to accumulate piles of data which is never looked at from one year to the next. I will end by quoting an old saying, which I defy anyone to translate, who is not familiar with North Country English: "If tha does owt for nowt, do it for thissen."

12.3.62.

REFERENCES

- | | |
|--|---|
| (1) Smith, G. W. "The Determination of Soil Moisture under a permanent grass cover." J. Geophys Res., 64, pp. 477-483, 1959. | (2) Brough, J. W. "Studies on Total Populations of Bacteria Fungi and Streptomycetes in Three Types of Soil." Quart. Rep. C.A.R.S., No. 1, pp. 49-52, 1962. |
|--|---|

CROP WEATHER CALENDAR

PROVINCE: MADRAS

DISTRICT: TANJORE

CROP: RICE (IRRIGATED)

[illegible]

Variety Trial

Location: Picton Pa 19A. Planted: 6/7/61.
Design: 21 x 4 Randomised Blocks Reaped: Young plants — 10/5/62.
Plot Size: 1/30th Acre
Soil Type: Alluvial.

Variety	Young plant			Sugar yield % of standard B 37161	Sugar yield % of standard B 37172	Pre-processing cost per ton sugar R(C/Y + H)
	TC/A	TC/TS	TS/A			
B 49119	27.84	9.67	2.88	166	139	\$152.98
B 55304	26.71	9.82	2.72	156	131	\$158.99
B 41227	25.50	9.41	2.71	156	131	\$156.30
B 55258	29.53	10.98	2.69	155	130	\$168.32
B 5557	24.37	9.41	2.59	149	125	\$160.44
B 55250	26.16	10.95	2.39	137	115	\$179.25
B 50112	25.41	10.68	2.38	137	115	\$177.82
B 55244	22.41	9.70	2.31	133	112	\$173.73
B 5527	21.19	9.29	2.28	131	110	\$172.14
B 55137	21.93	9.66	2.27	130	110	\$175.23
B 55317	25.78	11.51	2.24	129	108	\$190.03
B 5503	19.78	9.24	2.14	123	103	\$178.61
B 5599	23.43	10.95	2.14	123	103	\$190.97
B 55309	20.71	9.77	2.12	122	102	\$183.59
B 37172	21.09	10.19	2.07	119	100	\$189.33
B 5579	20.19	11.55	1.81	104	87	\$215.75
B 55111	19.21	10.73	1.79	103	96	\$211.27
B 55132	19.97	11.16	1.79	103	86	\$214.50
B 37161	18.84	10.83	1.74	100	84	\$215.95
B 55362	17.25	10.21	1.69	97	82	\$215.53
B 55109	16.68	11.05	1.51	87	73	\$238.57
LSD P = 0.05	8.46	3.77	1.71			

* Pre-processing cost per ton sugar was derived as follows:
R(C/Y + H), where R = TC/TS, *C = costs of cultivation per acre, Y = tons cane per
acre, and *H = harvesting costs. In the present case C = \$240 (BWI) and H = \$7.20,
probably higher than actual costs but relative ranking of varieties would not be altered.

Appendix 2.

Variety Trial

Location: Petit Morne 30
 Design: 5 x 5 Latin Square
 Plot Size: 1/30th Acre
 Soil Type: Princes Town Marl

Planted: 29/5/61
 Reaped: Young plants — 29/5/62

Duplicates of this trial are in Appendices 3 and 4.

Variety	Young plant			Sugar yield % of standard B 37161	Sugar yield % of standard B 37172	Pre processing cost per ton sugar R (C/Y + H)
	TC/A	TC/TS	TS/A			
B 49119	38.85	10.70	3.63	148	143	\$143.17
B 50112	36.07	11.10	3.25	132	128	\$153.74
B 37172	28.12	11.11	2.53	103	100	\$174.76
B 37161	26.77	10.93	2.45	100	97	\$176.74
BH 10/12	16.27	11.71	1.39	57	55	\$257.03
LSD P = 0.05	8.87	1.27	0.96			

Appendix 3.

Variety Trial

Location: Cedar Hill 15
 Design: 5 x 5 Latin Square
 Plot Size: 1/30th Acre
 Soil Type: Talparo Clay

Planted: 27/9/61
 Reaped: Young plants — 10/4/62

Duplicates of this trial are in Appendices 2 and 4.

Variety	Young plant			Sugar yield % of standard B 37161	Sugar yield % of standard B 37172	Pre-processing cost per ton sugar R (C/Y + H)
	TC/A	TC/TS	TS/A			
B 49119	27.60	11.36	2.43	159	129	\$180.62
B 37172	19.80	10.48	1.89	124	100	\$202.47
B 50112	22.80	12.13	1.88	124	99	\$215.06
B 37161	18.90	12.35	1.53	100	81	\$245.77
BH 10/12	6.90	11.69	0.59	32	32	\$406.59
LSD P = 0.05	4.13	1.99	0.44			

Appendix 4.

Variety Trial

Location : La Fortunee H 126
 Design : 5 x 5 Latin Square
 Plot Size : 1/30th Acre
 Soil Type : Alluvial
 Planted : 29/7/61
 Reaped : Young plants — 15/5/62

Duplicates of this trial are in Appendices 2 and 3.

Variety	Young plant			Sugar Yield % of standard B 37161	Sugar Yield % of standard B 37172	Pre-processing cost per ton sugar R(C/Y + H)
	TC/A	TC/TS	TS/A			
B 49119	20.62	9.73	2.12	164	140	\$183.31
B 50112	18.37	10.21	1.80	140	119	\$206.85
B 37172	15.15	10.03	1.51	117	100	\$231.09
B 37161	12.45	9.65	1.29	100	85	\$255.53
BH 10/12	6.60	9.85	0.67	52	44	\$429.06
LSD P = 0.05	4.67	1.17	0.48			

Variety Trial

Location: Picton Wellington 46/48 Planted: 18/8/60
 Design: 25 x 3 Randomised Blocks Reaped: Advanced plants — 22/1/62
 Plot Size: 1/30th Acre
 Soil Type: Talparo Clay

Variety	Advanced Plants			Sugar yield % of standard B 37161	Sugar yield % of standard B 37172	Pre-processing cost per ton sugar R (C/Y + H)
	TC/A	TC/TS	TS/A			
B 54262	56.00	9.09	6.16	170	190	\$104.44
B 50112	54.50	9.68	5.63	153	173	\$112.29
B 5449	45.75	9.51	4.81	130	148	\$118.40
B 45224	46.50	9.89	4.70	127	145	\$122.24
B 54142	43.25	9.34	4.63	125	142	\$119.08
B 49119	48.00	10.60	4.53	123	139	\$129.32
B 50135	41.00	9.28	4.42	120	136	\$121.10
B 5490	41.50	9.50	4.37	118	134	\$123.31
B 54172	44.50	10.18	4.37	118	134	\$128.17
B 54277	41.00	9.51	4.31	117	133	\$124.11
B 54215	42.00	9.88	4.25	115	131	\$127.55
B 54163	40.00	9.55	4.19	114	129	\$126.06
B 5463	41.50	10.07	4.12	112	127	\$130.70
B 5411	39.00	9.58	4.07	110	125	\$127.89
B 54235	39.50	9.80	4.03	109	124	\$130.14
B 5213	42.00	10.42	4.03	109	124	\$134.52
B 54237	37.25	9.27	4.02	109	124	\$126.44
B 54253	44.00	11.40	3.86	105	119	\$144.21
B 54193	41.50	10.95	3.79	103	117	\$142.13
B 5480	36.00	9.73	3.70	100	114	\$134.86
B 37161	40.75	11.04	3.69	100	114	\$144.51
B 5401	36.25	9.90	3.66	99	113	\$136.81
B 54243	35.00	9.89	3.54	96	109	\$139.05
B 54281	33.00	9.76	3.38	92	104	\$141.23
B 37172	35.00	10.77	3.25	88	100	\$151.43
LSD P = 0.05	20.80	2.49	2.33			

Appendix 6.

Variety Trial

Location : Petit Morne G.C. 23 *Planted :* 9/9/60

Design : 12 x 3 Randomised Blocks *Reaped :* Advanced plants—23/1/62

Plot Size : 1/30th Acre

Soil Type : Tarouba Clay

Variety	Advanced Plants			Sugar Yield % of standard B 37161	Pre-processing cost per ton sugar R (C/Y + H)
	TC/A	TC/TS	TS/A		
B 50112	52.75	9.90	5.33	127	\$116.32
B 49119	52.25	9.93	5.26	125	\$117.07
H 39-3633	43.25	9.26	4.67	111	\$118.07
B 37161	42.25	10.06	4.20	100	\$129.57
B 53329	37.50	9.40	3.99	95	\$127.84
B 45224	36.75	9.23	3.98	95	\$126.73
B 50135	39.00	9.92	3.93	94	\$132.43
Pindar	38.25	10.20	3.75	89	\$137.39
B 53200	36.50	9.97	3.66	87	\$137.39
B 41227	37.25	10.58	3.52	84	\$144.31
B 5352	33.25	9.53	3.49	83	\$137.42
H 32-8560	19.50	9.38	2.08	50	\$183.00
LSD P = 0.05	27.90	2.42	3.40		

Variety Trial

Location: Cedar Hill 3A
Design: 16 x 4 Randomised Blocks
Plot Size: 1/30th Acre
Soil Type: Talparo Clay

Planted: 3/5/60
Reaped: Young plants—23/5/61
 1st Ratoons—13/2/62

Variety	1st Ratoons			Sugar Yield % of standard B 37161		Sugar Yield % of standard B 37172		Total Yield TS/A for 2 crops	Pre-processing cost per ton sugar R(C/Y + H)
	TC/A	TC/TS	TS/A	1st Ratoons	Young Plants	1st Ratoons	Young Plants		
B 50112	37.12	10.40	3.57	180	124	151	124	9.62	\$142.17
B 51167	40.19	10.28	3.96	200	116	168	116	9.62	\$135.39
B 48231	39.00	10.77	3.62	183	115	153	115	9.25	\$143.78
B 49119	41.62	11.25	3.70	187	112	157	113	9.20	\$145.91
B 51355	37.12	11.67	3.18	161	121	137	121	9.11	\$159.53
B 50135	30.75	10.90	2.82	142	121	120	121	8.73	\$163.50
B 51168	33.38	9.91	3.37	170	107	143	107	8.62	\$142.60
B 48228	35.81	10.79	3.32	168	106	141	106	8.50	\$149.98
B 41227	33.47	10.83	3.09	156	110	131	110	8.46	\$155.63
B 45224	34.12	11.37	3.00	152	108	127	108	8.29	\$161.80
B 5124	27.19	10.18	2.67	135	107	113	107	7.92	\$163.19
B 37172	24.00	10.17	2.36	119	100	100	100	7.25	\$174.92
B 46378	26.81	10.43	2.57	130	94	109	94	7.18	\$168.44
B 50267	23.62	11.52	2.05	104	103	87	103	7.09	\$199.99
B 47314	23.25	9.98	2.33	118	95	99	95	7.00	\$174.85
B 37161	22.50	11.36	1.98	100	100	84	100	6.88	\$203.00
LSD P = 0.05	12.49	2.92	1.46						

Appendix 8.

Variety Trial

Location : La Fortunee 57
 Design : 12 x 3 Randomised Blocks
 Plot Size : 1/30th Acre
 Soil Type : Black Alluvial

Planted : 24/8/60
 Reaped : Young plants — 18/5/61
 1st Ratoons — 19/3/62

Variety	1st Ratoons			Sugar yield % of standard B 37161		Total yield TS/A for 2 crops Young Plants + Ratoons	Pre-processing cost per ton sugar R (C/Y + H)
	TC/A	TC/TS	TS/A	1st Ratoons	Young Plants		
B 49119	41.37	9.62	4.30	126	145	7.21	\$125.06
B 50112	38.75	9.31	4.16	122	122	6.61	\$124.66
B 50135	35.75	9.33	3.83	112	136	6.56	\$129.78
B 52316	38.37	8.86	4.33	127	106	6.46	\$119.17
B 41227	40.00	9.55	4.19	123	112	6.44	\$126.06
Pindar	39.00	9.40	4.15	122	97	6.09	\$125.49
B 45224	37.12	9.21	4.03	118	98	5.99	\$125.90
H39-3633	38.37	9.57	4.01	118	97	5.96	\$127.76
H39-5803	31.38	9.72	3.23	95	120	5.65	\$144.34
B 37161	31.62	9.72	3.41	100	100	5.42	\$143.76
Eros	27.49	10.30	2.67	78	102	4.73	\$164.08
H32-8560	23.75	9.06	2.62	77	91	4.45	\$156.83
LSD P = 0.05	10.16	1.61	1.33				

Appendix 9.

Variety Trial

Location : Williamsville Brs. 30/31

Planted : 19/6/59

Design : 16 x 4 Randomised Blocks

Reaped : Young plants — 3/6/60

Plot Size : 1/30th Acre

1st Ratoons — 15/3/61

Soil Type : Talparo Clay

2nd Ratoons — 22/2/62

Variety	2nd Ratoons			Sugar yield % of standard B 37161			Sugar yield % of standard B 37172			Total Yield TS/A for 3 crops			Pre-processing cost per ton sugar R (C/Y + H)
	TC/A	TC/TS	TS/A	2nd Ratoons	1st Ratoons	Young Plants	2nd Ratoons	1st Ratoons	Young Plants	Young Plants +	1st Ratoons +	2nd Ratoons	
B 49119	45.19	8.77	5.15	141	159	137	133	157	133	15.18			\$109.71
B 48372	43.69	8.92	4.90	137	152	145	127	150	141	15.01			\$113.19
B 41227	45.00	9.15	4.92	134	148	134	128	146	130	14.51			\$114.65
B 4744	41.81	8.99	4.65	127	141	141	121	140	138	14.31			\$116.33
B 47204	41.25	8.87	4.65	127	140	119	121	139	116	13.45			\$115.49
B 4747	37.50	8.48	4.42	120	136	115	114	134	111	12.92			\$115.33
B 45224	37.69	8.77	4.30	117	130	116	111	128	113	12.65			\$119.00
B 46378	34.50	8.76	3.94	107	123	119	102	121	116	12.29			\$124.04
B 4847	35.44	8.73	4.06	110	106	100	105	104	98	11.05			\$121.96
B 37172	35.06	9.11	3.85	105	101	103	100	100	100	10.80			\$128.00
B 41211	34.31	8.84	3.88	106	87	110	101	86	107	10.60			\$125.53
B 37161	31.87	8.71	3.66	100	100	100	94	99	98	10.46			\$128.30
LSD P = 0.05	7.42	1.44	0.93										

Appendix 11

Variety Trial

Location : Petit Morne Gc. 19 Planted 1/10/58

Design : 12 x 4 Randomised Blocks Reaped : Advanced plants — 6/4/60

Plot Size : 1/30th Acre

1st Ratoons — 1/4/61

2nd Ratoons — 4/5/62

Variety	2nd Ratoons			Sugar yield % of standard B 37161			Sugar Yield % of standard B 37172			Total yield TS/A for 3 crops			Pre-processing cost per ton sugar R (C/Y + H)
	TC/A	TC/TS	TS/A	2nd Ratoons	1st Ratoons	Advanced Plants	2nd Ratoons	1st Ratoons	Advanced plants	Advanced Plants +	1st Ratoons	2nd Ratoons	
B 49119	32.16	8.67	3.71	133	136	114	165	174	176	13.57			\$127.10
B 46378	26.06	8.07	3.23	115	125	103	144	159	159	12.18			\$132.43
B 41227	28.41	8.16	3.48	124	114	92	155	145	142	11.57			\$127.70
B 4747	26.25	8.20	3.20	114	114	99	142	145	152	11.56			\$133.99
B 4744	22.87	8.20	2.79	99	107	95	124	136	147	10.75			\$145.06
B 37161	22.97	8.20	2.80	100	100	100	124	128	154	10.71			\$144.73
B 41211	22.68	8.25	2.75	98	111	91	122	142	140	10.70			\$146.69
B 48372	27.00	8.54	3.16	113	101	82	140	130	133	10.54			\$137.41
B 45224	23.25	8.45	2.75	98	111	79	122	142	122	10.20			\$148.04
B 47204	23.53	8.11	2.90	104	91	85	129	117	131	9.86			\$141.11
B 4847	26.53	8.61	3.08	110	109	65	137	139	100	9.84			\$139.91
B 37172	18.75	8.33	2.25	80	78	65	100	100	100	7.88			\$166.52
LSD P = 0.05	9.19	0.94	1.13										

Appendix 12

Variety Trial

Location : Picton Pa. 8

Planted : 1/9/58

Design : 12 x 4 Randomised Blocks

Reaped : Advanced plants—18/4/60

Plot Size : 1/30th Acre

(These results are not accurate due to a fire).

Soil Type : Alluvial

1st Ratoons — 23/2/62

2nd Ratoons — 31/3/62

Variety	2nd Ratoons			Sugar yield % of standard B 37161		Sugar yield % of standard B 37172		Total yield TS/A for 2 crops		Pre-processing cost per ton sugar R(C/Y + H)
	TC/A	TC/TS	TS/A	2nd Ratoons	1st Ratoons	2nd Ratoons	1st Ratoons	1st + 2nd Ratoons	Ratoons	
B 49119	46.88	9.91	4.73	124	167	141	250	9.87		\$122.09
B 41227	47.63	9.12	5.22	137	137	156	205	9.44		\$111.63
B 48372	41.06	8.98	4.57	120	139	136	207	8.83		\$117.19
B 46378	42.75	9.85	4.34	114	124	130	184	8.14		\$126.18
B 47204	40.69	9.51	4.28	112	110	128	164	7.66		\$124.58
B 45224	40.78	9.35	4.36	114	101	130	150	7.45		\$121.55
B 4747	36.94	9.77	3.78	99	108	113	161	7.10		\$133.85
B 4744	36.47	8.81	4.14	108	96	124	144	7.10		\$121.40
B 41211	39.29	9.35	4.20	110	93	125	138	7.05		\$124.45
B 37161	37.78	9.89	3.82	100	100	114	149	6.89		\$134.00
B 4847	39.38	9.65	4.08	107	82	122	122	6.60		\$128.25
B 37172	30.75	9.18	3.35	88	67	100	100	5.41		\$137.70
LSD P = 0.05	11.51	1.49	1.59							

Variety Trial

Location : La Fortunee B.V. 52 Planted : 4/9/58
Design : 12 x 4 Randomised Blocks Reaped : Advanced plants — 4/2/60
Plot Size : 1/30th Acre 1st Ratoons — 20/3/61
Soil Type : Black Alluvial 2nd Ratoons — 10/2/62

Variety	2nd Ratoons			Sugar Yield % of standard B 37161			Sugar Yield % of standard B 37172			Total yield T/SA for 3 crops	Pre-processing cost per ton sugar R(C/Y + H)
	TC/A	TC/TS	TS/A	2nd Ratoons	1st Ratoons	Advanced Plants	2nd Ratoons	1st Ratoons	Advanced Plants	Advanced Plants + 1st Ratoons + 2nd Ratoons	
B 41227	41.44	9.91	4.18	146	118	122	157	133	126	15.57	\$128.73
B 49119	39.75	9.14	4.35	152	113	117	164	127	122	15.26	\$121.01
B 45224	39.56	9.99	3.96	138	109	98	149	124	102	13.83	\$132.57
B 47204	36.37	9.21	3.95	138	96	104	149	108	108	13.46	\$127.10
B 4747	36.00	9.16	3.93	137	100	99	148	113	103	13.40	\$127.05
B 48372	34.31	9.32	3.68	128	107	88	138	121	92	12.95	\$132.34
B 4744	27.75	9.22	3.01	105	98	106	113	111	111	12.71	\$146.14
B 46378	32.44	9.49	3.42	119	110	81	129	125	84	12.51	\$138.55
B 37161	27.38	9.54	2.87	100	100	100	108	113	104	12.37	\$152.35
B 41211	32.62	9.51	3.43	120	105	69	129	119	72	11.75	\$138.47
B 4847	35.62	9.95	3.58	125	102	63	135	115	66	11.45	\$138.70
B 37172	26.06	9.80	2.66	93	89	96	100	100	100	11.43	\$160.82
LSD P = 0.05	10.65	1.45	1.24								

Appendix 14

Variety Trial

Location : Reform 36

Planted : 1/7/59

Design : 16 x 4 Randomised Blocks

Reaped : Young plants—7/6/60

Plot Size : 1/30th Acre

(Results are unreliable, due to
damage from cane tops being stolen)

Soil Type : Sevilla Clay

1st Ratoons — 5/4/61

2nd Ratoons — 19/1/62

Variety	2nd Ratoons			Sugar Yield % of standard B 37161		Sugar Yield % of standard B 37172		Total Yield T/SA for 2 crops		Pre-processing cost per ton sugar R(C/Y + H)
	TC/A	TC/TS	TS/A	2nd Ratoons	1st Ratoons	2nd Ratoons	1st Ratoons	1st Ratoons + 2nd Ratoons		
B 49119	31.32	10.41	3.01	166	132	182	155	7.85		\$154.69
B 48231	34.13	11.61	2.94	162	127	178	150	7.63		\$165.21
B 50112	28.50	10.29	2.77	153	121	168	143	7.24		\$160.73
B 41227	28.88	11.15	2.59	143	124	157	147	7.17		\$172.94
B 50135	26.07	10.51	2.48	137	126	150	148	7.10		\$172.47
B 48228	30.20	10.41	2.90	160	110	176	129	6.94		\$157.71
B 51355	28.32	11.80	2.40	133	121	145	143	6.86		\$184.91
B 45224	23.63	10.64	2.22	123	105	135	124	6.09		\$184.71
B 5124	22.50	11.31	1.99	110	111	121	131	6.07		\$202.11
B 46378	23.63	11.36	2.08	115	102	126	120	5.83		\$197.21
B 47314	20.25	12.27	1.65	91	108	100	127	5.61		\$233.74
B 37161	21.00	11.60	1.81	100	100	110	118	5.49		\$216.11
B 50267	21.37	11.13	1.92	106	90	116	107	5.25		\$205.13
B 51168	20.63	11.40	1.81	100	89	110	105	5.08		\$214.66
B 37172	16.97	10.28	1.65	91	85	100	100	4.77		\$219.38
B 51167	16.50	10.86	1.52	84	86	92	102	4.70		\$236.21
LSD P = 0.05	10.52	2.81	1.20							

Appendix 15.

Variety Trial

Location: Reform H.H. 34B

Design: 22 x 4 Randomised Blocks

Plot Size: 1/30th Acre

Soil Type: Sevilla Clay

Planted: 13/8/58

Reaped: Advanced plants — 20/1/60

1st Ratons — 28/1/61

2nd Ratoons — 11/1/62

[illegible]

Appendix 16.

Variety Trial

Location: Petit Morne R 1

Planted: 26/9/57

Design: 4 x 13 Incomplete Blocks

Reaped: Advanced plants — 26/1/59

Plot Size: 1/30th Acre

1st Ratoons — 31/3/60

Soil Type: Alluvial Black

2nd Ratoons — 20/4/62

3rd Ratoons — 7/4/62

[illegible]

Appendix 17.

Variety Trial

Location: La Fortunee B.V. 31

Planted: 12/4/58

Design: 10 x 5 Randomised Blocks

Reaped: Young plants — 16/4/59

Plot Size: 1/30th Acre

1st Ratoons — 2/3/60

Soil Type: Alluvial Black

2nd Ratoons — 23/3/61

3rd Ratoons — 3/2/62

Variety	3rd Ratoons			Sugar yield % of standard B 37161				Sugar yield % of standard B 37172				Total yield TS/A for 4 crops				Pre-processing cost per ton sugar R(C, Y + H)
	TC/A	TC/TS	TS/A	3rd Ratoons	2nd Ratoons	1st Ratoons	Young Plants	3rd Ratoons	2nd Ratoons	1st Ratoons	Young Plants	Young Plants	+ 1st Ratoons	+ 2nd Ratoons	+ 3rd Ratoons	
B 48372	42.75	12.25	3.49	136	168	235	136	119	126	137	102	19.03				\$156.92
B 4747	42.00	11.90	3.53	138	160	222	143	120	120	129	107	18.63				\$153.63
B 45224	37.05	11.76	3.15	123	152	207	153	107	114	120	115	18.21				\$160.88
B 4744	32.10	10.92	2.94	115	145	189	138	100	109	110	104	16.89				\$160.31
B 46378	42.00	12.28	3.42	134	129	206	125	116	97	120	93	16.56				\$158.53
B 47204	40.72	11.50	3.54	138	135	180	114	120	101	105	86	16.05				\$150.54
B 37172	31.80	10.82	2.94	115	133	172	134	100	100	100	100	15.96				\$159.60
B 4847	40.65	12.17	3.34	130	140	136	106	114	105	79	80	15.16				\$159.43
B 41211	34.57	11.33	3.05	119	136	155	110	104	102	90	82	14.99				\$160.21
B 37161	28.95	11.31	2.56	100	100	100	100	87	75	58	75	11.79				\$175.19
LSD P = 0.05	12.45	4.14	1.25													

Appendix 18.

Variety Trial

Location : La Fortunee H 41

Design : 4 x 13 Incomplete Blocks

Plot Size : 1/30th Acre

Soil Type : Princes Town Marl

Planted : 23/9/57

Reaped : Advanced plants — 2/7/59

1st Ratoons — 10/3/60

2nd Ratoons — 13/4/61

3rd Ratoons — 27/3/62

Variety	3rd Ratoons			Sugar yield % of standard B 37161				Sugar yield % of standard B 37172				Total Yield TS/A for 4 crops					Pre-processing cost per ton sugar R(C/Y + H)
	TC/A	TC/TS	TS/A	3rd Ratoons	2nd Ratoons	1st Ratoons	Advanced Plants	3rd Ratoons	2nd Ratoons	1st Ratoons	Advanced Plants	Advanced Plants	+ 1st Ratoons	+ 2nd Ratoons	+ 3rd Ratoons		
B 47204	34.31	9.05	3.79	134	112	115	128	146	130	150	120	18.41					\$128.51
B 51353	29.62	8.74	3.39	120	121	99	122	131	141	129	114	17.64					\$133.72
B 51355	33.56	9.19	3.65	129	107	113	114	141	125	148	107	17.34					\$131.88
B 46102	36.56	9.52	3.84	136	108	118	104	148	126	153	97	17.31					\$131.00
H32-8560	30.75	9.15	3.36	119	93	93	114	130	108	120	106	15.70					\$137.25
B 51168	23.81	9.37	2.54	90	97	93	117	98	113	122	109	15.27					\$161.91
B 37161	25.87	9.17	2.82	100	100	100	100	109	117	130	93	15.15					\$151.12
B 45224	29.81	9.62	3.10	110	98	92	100	120	114	119	93	15.06					\$146.70
B 5178	26.62	9.34	2.85	101	90	89	114	110	105	116	107	15.01					\$151.49
B 5124	21.75	9.53	2.28	81	104	97	106	88	121	126	99	14.96					\$173.73
B 51134	28.97	9.69	2.99	106	96	75	108	115	112	97	101	14.68					\$150.00
B 37172	24.75	9.56	2.59	92	86	77	107	100	100	100	100	13.82					\$161.56
B 51167	23.34	9.34	2.50	89	78	82	105	97	91	107	99	13.45					\$163.26
LSD P = 0.05	13.42	1.56	1.49														

Variety Trial

Estate: Brechin Castle *Planted:* 24/6/57
Section: Brechin Castle *Reaped:* Plants — 12/6/58
Field: Estate 89 1st Ratoons — 23/4/59
Design: 5 x 5 Latin Square 2nd Ratoons — 14/4/60
Plot Size: 1/60th acre 3rd Ratoons — 14/3/61
Soil Type: Couva Loam and Clay 4th Ratoons — 6/1/62

Variety	4th Ratoons			Sugar Yield Per Cent of Standard					Total Yield TS/A for 5 crops. Plants, 1st, 2nd, 3rd, and 4th Ratoons
	TS/A	TC/TS	TS/A	4th Ratoons	3rd Ratoons	2nd Ratoons	1st Ratoons	Plants	
B 49119	22.51	9.07	2.52	107.2	104.3	103.7	123.7	93.5	16.19
B 41227	24.95	9.81	2.35	100.0	100.0	100.0	100.0	100.0	15.45
B 52178	21.41	8.64	2.44	103.8	81.4	85.2	100.0	86.2	13.76
H44/3098	22.68	8.88	2.42	103.0	84.5	81.5	91.9	90.3	13.67
B 5011	17.59	9.16	1.76	74.9	73.0	77.1	96.8	87.9	12.49
LSD at .01%	4.89	0.73	0.52						
LSD at .05%	3.49	0.52	0.37						

Appendix 20.

Variety Trial

<i>Estate :</i>	Brechin Castle	<i>Planted :</i>	22/7/58
<i>Section :</i>	Brechin Castle	<i>Reaped :</i>	Plants — 1/5/59
<i>Field :</i>	Estate 36		1st Ratoons — 29/4/60
<i>Design :</i>	5 x 5 Latin Square — Reaped as a 5 x 4 Randomised Block		2nd Ratoons — 13/3/61
<i>Plot Size :</i>	1/40th acre		3rd Ratoons — 26/4/62
<i>Soil Type :</i>	Couva Loam and Clay		

Variety	3rd Ratoons			Sugar Yield Per Cent of Standard				Total Yield TS/A for 4 crops . Plants, 1st, 2nd, and 3rd Ratoons
	TC/A	TC/TS	TS/A	3rd Ratoons	2nd Ratoons	1st Ratoons	Plants	
B 50347	31.60	11.31	2.82	111.9	102.9	101.1	108.5	14.35
B 50112	28.59	10.89	2.63	104.4	117.4	99.4	105.8	14.15
B 41227	26.76	10.70	2.52	100.0	100.0	100.0	100.0	13.36
B 50135	26.06	10.74	2.45	97.2	104.5	91.1	107.6	13.14
B 50377	22.08	8.39	2.64	104.8	85.6	86.7	67.0	11.56
LSD at .01%	4.17	1.74	—					
LSD at .05%	2.96	1.24	—					

Appendix 21.

Variety Trial

Estate : Brechin Castle
 Section : Perseverance
 Field : 3 Cooper Shop
 Design : 6 x 6 Latin Square
 Plot Size : 1/40th acre
 Soil Type : Waterloo Loam and Clay

Planted : 17/7/58
 Reaped : Plants — 1/5/59
 1st Ratoons — 20/4/60
 2nd Ratoons — 1/3/61
 3rd Ratoons — 21/2/62

Variety	3rd Ratoons			Sugar Yield Per Cent of Standard				Total Yield TS/A for 4 crops, Plants, 1st, 2nd, and 3rd Ratoons
	TC/A	TC/TS	TS/A	3rd Ratoons	2nd Ratoons	1st Ratoons	Plants	
B 49119	33.95	8.87	3.82	111.0	117.5	105.3	94.4	16.24
B 41227	31.91	9.42	3.44	100.0	100.0	100.0	100.0	14.98
B 47419	33.15	10.18	3.26	94.7	96.5	95.1	74.9	13.76
B 5011	28.01	8.68	3.26	94.7	84.2	90.0	97.8	13.59
B 4362	32.11	9.47	3.39	98.5	84.6	98.1	73.4	13.44
B 4098	29.54	9.11	3.25	94.5	79.8	86.5	84.3	12.87
LSD at .01%	4.41	0.80	0.46					
LSD at .05%	3.23	0.58	0.33					

Variety Trial

Estate: Brechin Castle *Planted:* 24/6/57
Section: Exchange *Reaped:* 2 Yr. Plants — 9/1/59
Field: Dev. 35 A. 1st Ratoons — 5/1/60
Design: 5 x 5 Latin Square 2nd Ratoons — 28/12/60
Plot Size: 1/60th acre 3rd Ratoons — 3/1/62
Soil Type: Mc Bean Sand and Loam

Variety	3rd Ratoons			Sugar Yield Per Cent of Standard					Total Yield TS/A for 4 crops. 2 Yr. Plants, 1st, 2nd, and 3rd Ratoons
	TC/A	TC/TS	TS/A	3rd Ratoons	2nd Ratoons	1st Ratoons	2 Yr. Plants		
B 50112	29.66	9.02	3.29	118.8	112.8	105.0	130.7	14.75	
B 45267	27.01	9.30	2.91	105.1	93.0	108.2	112.8	13.26	
B 41227	25.80	9.28	2.77	100.0	100.0	100.0	100.0	12.70	
H32/8560	22.47	8.61	2.60	93.9	96.6	102.2	101.9	12.47	
B 46297	18.50	8.31	2.23	80.5	82.6	95.0	110.9	11.78	
LSD at .01%	3.48	0.88	0.40						
LSD at .05%	2.48	0.63	0.28						

Appendix 23.

Variety Trial

Estate: Waterloo Planted: 5/6/59
 Section: Wyaby Reaped: Plants — 4/5/60
 Field: Estate 15 1st Ratoons — 8/3/61
 Design: 5 x 5 Latin Square 2nd Ratoons — 2/3/62
 Plot Size: 1/40th acre
 Soil Type: Mc Bean Sand and Loam

Variety	2nd Ratoons			Sugar Yield Per Cent of Standard			Total Yield TS/A for 3 crops. Plants, 1st, and 2nd Ratoons
	TC/A	TC/TS	TS/A	2nd Ratoons	1st Ratoons	Plants	
B 49119	39.13	8.35	4.67	149.2	101.9	114.0	11.99
B 41227	38.11	10.72	3.56	100.0	100.0	100.0	10.48
B 4995	30.42	10.12	3.00	95.8	88.5	123.4	9.90
B 50126	29.72	8.65	3.43	109.6	89.6	90.1	9.64
B 49354	27.86	9.04	3.08	98.4	79.8	82.0	8.65
LSD at .01%	5.99	0.70	0.68				
LSD at .05%	4.27	0.50	0.48				

Appendix 24.

Variety Trial

Estate: Woodford Lodge *Planted:* 18/6/59
Section: Felicite *Reaped:* Plants — 19/4/60
Field: 7 W 4 1st Ratoons — 30/3/61
Design: 5 x 5 Latin Square 2nd Ratoons — 20/2/62
Plot Size: 1/40th acre
Soil Type: Bejucal Heavy Clay

Variety	2nd Ratoons			Sugar Yield Per Cent of Standard			Total Yield TS/A for 3 crops. Plants, 1st, and 2nd Ratoons
	TC/A	TC/TS	TS/A	2nd Ratoons	1st Ratoons	Plants	
B 49119	21.67	9.02	2.41	143.5	116.4	94.2	10.68
B 5121	20.51	10.84	1.90	113.10	102.3	100.0	9.83
B 41227	19.85	11.82	1.68	100.0	100.0	100.0	9.51
B 45224	11.91	12.52	0.97	57.73	89.1	78.2	7.52
B 5124	11.45	9.66	1.20	71.43	81.1	65.6	6.96
LSD at .01%	4.77	1.29	1.65				
LSD at .05%	3.40	0.92	1.17				

Appendix 25.

Variety Trial

Estate : Brechin Castle *Planted :* 16/6/59
Section : Perseverance *Reaped :* Plants — 18/5/60
Field : 10 Acre 1st Ratoons — 15/3/61
Design : 5 x 5 Latin Square 2nd Ratoons — 22/2/62
Plot Size : 1/60th acre
Soil Type : Waterloo Loam and Clay

Variety	2nd Ratoons			Sugar Yield Per Cent of Standard			Total Yield TS/A for 3 crops. Plants, 1st, and 2nd Ratoons
	TC/A	TC/TS	TS/A	2nd Ratoons	1st Ratoons	Plants	
B 49119	36.94	7.91	4.66	113.1	105.5	117.9	12.92
B 41227	33.90	8.89	3.82	100.0	100.0	100.0	11.32
B 50112	32.75	8.81	3.73	97.6	84.7	92.9	10.41
B 50135	29.40	9.22	3.21	84.0	82.1	96.4	9.67
B 5011	23.51	8.56	2.76	72.3	71.1	82.1	8.40
LSD at .01%	5.53	1.04	0.70				
LSD at .05%	3.94	0.74	0.50				

Variety Trial

<i>Estate :</i>	Gordon	<i>Planted :</i>	30/6/59
<i>Section :</i>	Phoenix Park	<i>Reaped :</i>	Plants — 22/2/60
<i>Field :</i>	Px. 22 West		1st Ratoons — 23/2/61
<i>Design :</i>	5 x 5 Latin Square		2nd Ratoons — 10/1/62
<i>Plot Size :</i>	1/40th acre		
<i>Soil Type :</i>	Cunupia, Sevilla and Basseterre Series		

Variety	2nd Ratoons			Sugar Yield Per Cent of Standard			Total Yield TS/A for 3 crops. Plants, 1st, and 2nd Ratoons
	TC/A	TC/TS	TS/A	2nd Ratoons	1st Ratoons	Plants	
B 49119	34.18	11.04	3.09	124.6	111.9	95.2	9.62
B 41227	32.78	13.29	2.48	100.0	100.0	100.0	8.63
B 3337	31.36	11.21	2.79	112.5	89.6	66.7	7.82
B 4098	26.96	11.55	2.33	94.0	78.3	79.0	7.16
B 4744	29.44	13.57	2.16	87.1	74.3	81.0	6.87
LSD at .01%	6.57	0.46	0.52				
LSD at .05%	4.68	0.33	0.37				

Variety Trial

Estate: Caroni *Planted:* 19/6/59
Section: Washington *Reaped:* Plants — 10/5/60
Field: Fred. 110 1st Ratoons — 27/3/61
Design: 5 x 5 Latin Square 2nd Ratoons — 1/3/62
Plot Size: 1/40th acre
Soil Type: Bejucal Very Heavy Clay

Variety	2nd Ratoons			Sugar Yield Per Cent of Standard			Total Yield TS/A for 3 crops, Plants, 1st, and 2nd Ratoons
	TC/A	TC/TS	TS/A	2nd Ratoons	1st Ratoons		
					Plants		
B 49119	19.38	9.79	1.99	176.1	114.2	161.9	8.83
B 51353	14.08	14.67	1.01	89.4	104.8	156.6	7.44
B 41227	14.97	13.77	1.13	100.0	100.0	100.0	6.33
B 37161	13.81	11.81	1.17	89.4	89.4	101.1	6.04
B 45224	11.70	15.10	0.77	81.0	81.0	107.4	5.48
LSD at .01%	—	3.48	0.73				
LSD at .05%	5.95	2.48	0.52				

Appendix 28.

Variety Trial

Estate: Waterloo *Planted:* 25/6/60
Section: Mc Bean *Reaped:* Plants — 13/4/61
Field: Estate 23 1st Ratoons — 30/3/62
Design: 5 x 5 Latin Square
Plot Size: 1/40th acre
Soil Type: Mc Bean Sand and Loam

Variety	1st Ratoons			Sugar Yield Per Cent of Standard		Total Yield TS/A for 2 crops. Plants, 1st Ratoons
	TC/A	TC/TS	TS/A	Plants		
				1st Ratoons	Plants	
B 41227	38.74	8.35	4.66	100.0	100.0	7.37
B 50112	39.03	9.34	4.19	89.9	100.7	6.92
B 5121	36.74	9.24	3.93	84.3	106.3	6.81
B 49119	30.51	7.73	3.95	84.8	91.5	6.43
B 50135	32.21	10.18	3.33	71.5	96.7	5.95
LSD at .01%	—	—	—			
LSD at .05%	8.10	1.99	—			

Appendix 29.

Variety Trial

Estate : Brechin Castle Planted : 25/6/60
Section : Exchange Reaped : Plants — 5/5/61
Field : Estate 46 1st Ratoons — 31/5/62
Design : 6 x 6 Latin Square
Plot Size : 1/40th acre
Soil Type : Freeport Clay

Variety	1st Ratoons			Sugar Yield Per Cent of Standard		Total Yield TS/A for 2 crops. Plants, 1st Ratoons
	TC/A	TC/TS	TS/A	1st Ratoons	Plants	
B 49119	37.00	7.65	4.83	96.9	108.6	8.11
B 41227	38.29	7.69	4.98	100.0	100.0	8.00
B 50112	38.49	9.01	4.29	86.1	102.0	7.37
B 5121	34.58	8.56	4.04	81.1	102.0	7.12
B 50135	37.29	9.08	4.12	82.7	87.1	6.75
B 51353	32.13	8.80	3.65	73.2	61.3	5.50
LSD at .01%	6.31	0.69	0.77			
LSD at .05%	4.63	0.50	0.57			

Appendix 30.

Variety Trial

<i>Estate :</i>	Gordon	<i>Planted :</i>	8/7/60
<i>Section :</i>	Esperanza	<i>Reaped :</i>	Plants — 26/5/61
<i>Field :</i>	S.P. 15		1st Ratoons — 26/6/62
<i>Design :</i>	5 x 5 Latin Square		
<i>Plot Size :</i>	1/40th acre		
<i>Soil Type :</i>	Cunupia — Sevilla Soil Association		

Variety	1st Ratoons			Sugar Yield		Total Yield TS/A for 2 Crops. Plants, 1st Ratoons
	TC/A	TC/TS	TS/A	Per Cent of Standard	Plants	
B 50112	45.50	10.57	4.33	102.3	130.9	8.40
B 5121	40.11	10.57	3.79	89.5	125.4	7.69
B 49119	37.28	9.61	3.96	92.1	114.1	7.51
B 41227	38.25	9.08	4.23	100.0	100.0	7.34
B 50347	36.89	10.44	3.53	83.4	85.3	6.19
LSD at .01%	6.72		0.76			
LSD at .05%	4.79	1.25	0.54			

Appendix 31.

Variety Trial

Estate : Woodford Lodge Planted : 14 — 16/6/60
 Section : Felicite Reaped : Plants — 14/4/61
 Field : Bco. 23 1st Ratoons — 23/3/62
 Design : 5 x 5 x 3 Lattice Square
 Plot Size : 1/60th acre
 Soil Type : Waterloo Loam and Clay

Variety	1st Ratoons			Sugar Yield Per Cent of Standard		Total Yield TS/A for 2 crops. Plants, 1st Ratoons
	TC/A	TC/TS	TS/A	1st Ratoons	Plants	
B 5557	34.03	8.30	4.09	104.1	120.9	8.14
B 50112	37.46	9.11	4.15	105.6	100.0	7.54
B 41227	32.35	8.24	3.93	100.0	101.2	7.28
B 55258	36.63	10.32	3.53	89.8	103.9	7.01
B 49119	25.18	8.05	3.13	79.6	104.5	6.63
B 55309	31.30	8.76	3.58	91.1	86.6	6.48
B 55132	26.93	8.21	3.30	84.0	92.2	6.39
B 5503	36.88	8.13	3.31	84.2	91.6	6.38
B 5121	26.34	8.42	3.13	79.6	94.6	6.30
B 55362	23.47	7.33	3.23	82.2	90.5	6.26
H 39/5803	25.61	8.28	3.11	79.1	91.3	6.17
B 50135	28.12	9.14	3.07	78.1	89.6	6.07
B 5124	26.48	8.06	3.28	83.5	78.5	5.91
B 55250	26.32	8.68	3.04	77.4	85.7	5.91
H 38/2915	26.39	9.35	2.83	72.0	91.3	5.89
B 55244	28.81	9.73	2.97	75.6	84.2	5.79
B 55304	22.64	8.08	2.97	71.0	89.0	5.77
B 55137	22.12	8.22	2.70	68.7	88.4	5.66
B 55317	26.95	10.52	2.83	72.0	83.8	5.64
B 5527	19.27	8.10	2.40	61.1	91.3	5.46
B 51353	23.92	9.27	2.57	65.3	80.3	5.26
B 55111	23.17	10.19	2.29	58.3	85.4	5.15
B 55109	20.56	9.03	2.29	58.3	76.1	4.84
B 5599	30.18	12.45	2.44	62.1	62.1	4.25
B 5579	24.47	12.43	1.96	49.9	63.3	4.08
LSD at .01%	7.27	0.98	0.53			
LSD at .05%	5.30	0.72	0.39			

Appendix 32.

Variety Trial

Estate : Waterloo Planted : 19—21/7/60
 Section : Waterloo Reaped : Plants — 16/5/61
 Field : Estate 11 1st Ratoons — 28/3/62
 Design : 5 x 5 x 3 Lattice Square
 Plot Size : 1/60th acre
 Soil Type : Waterloo Loam and Clay

Variety	1st Ratoons			Sugar Yield Per Cent of Standard		Total Yield TS/A for 2 crops. Plants, 1st Ratoons
	TC/A	TC/TS	TS/A	1st Ratoons	Plants	
B 50112	38.92	9.81	3.97	98.3	134.3	7.53
B 49119	34.91	8.26	4.23	104.7	119.2	7.39
B 5401	32.73	7.84	4.19	103.7	104.5	6.96
B 41227	34.50	8.53	4.04	100.0	100.0	6.69
B 54227	36.64	8.33	4.39	108.7	82.3	6.57
B 5480	29.65	8.34	3.55	87.9	110.9	6.49
B 54142	29.88	8.07	3.71	91.8	96.6	6.27
B 5449	29.42	8.27	3.55	88.1	99.6	6.20
B 5490	28.53	8.36	3.42	84.7	102.6	6.14
B 54262	34.34	9.71	3.56	88.1	93.3	6.06
B 54215	29.22	8.96	3.26	80.7	105.7	6.06
B 5121	35.87	11.56	3.10	76.7	109.4	6.00
H 39/3633	31.32	8.82	3.55	87.9	91.3	5.97
B 54193	29.90	9.43	3.17	78.5	100.8	5.84
B 5463	31.21	9.47	3.32	82.	91.3	5.74
B 50135	33.25	10.26	3.29	81.4	92.1	5.73
B 54163	28.82	7.68	3.75	92.8	73.2	5.69
B 5411	30.07	9.49	3.17	78.5	90.9	5.58
B 50347	35.45	11.17	3.17	78.5	82.3	5.35
B 54281	27.69	8.35	3.31	81.9	76.2	5.33
B 54243	29.93	8.72	2.97	73.5	84.2	5.20
B 54235	25.15	9.48	2.65	65.6	90.6	5.05
B 54253	29.13	9.22	2.50	61.9	93.2	4.97
B 54237	24.14	9.41	2.57	63.6	88.3	4.91
B 54172	24.47	8.37	2.92	72.3	48.2	4.20
LSD at .01%	6.83	1.54	0.93			
LSD at .05%	5.04	1.13	0.60			

Appendix 33.

Fertilizer Trial

<i>Estate :</i>	Caroni	<i>Planted :</i>	1.7.61
<i>Section :</i>	Curepe	<i>Reaped :</i>	Plants — 17.4.62
<i>Field :</i>	F. 155		
<i>Design :</i>	3 x 3 x 3 (NPK) Factorial		
<i>Plot Size :</i>	1/40th acre		
<i>Soil Type :</i>	Frederick Very Heavy Clay		
<i>Variety :</i>	B 41227		

Results (TS/A)

Analysis of Variance

Source of Variation	Degrees of Freedom	'F' Ratio to Error
Nitrogen	2	5.95 x
Phosphorus	2	4.71 x
Potassium	2	1.12 n.s.
Interactions: NK	1	5.93 x

n.s. = Not Significant

x = Significant at 5% level.

Main Treatment Effects

Sulphate of Ammonia (21% N)		Triple Super Phosphate (40% P ₂ O ₅)		Muriate of Potash (60% K ₂ O)	
Treatment	Yield (TS/A)	Treatment	Yield (TS/A)	Treatment	Yield (TS/A)
2 cwt/acre	1.33	0 cwt/acre	1.32	0 cwt/acre	1.39
4 cwt/acre	1.44	2 cwt/acre	1.48	2 cwt/acre	1.50
6 cwt/acre	1.62	4 cwt/acre	1.58	4 cwt/acre	1.50

L.S.D. at 0.05 = 0.18

L.S.D. at 0.01 = 0.25

Appendix 34.

Fertilizer Trial

<i>Estate :</i>	Brechin Castle	<i>Date Planted :</i>	16/7/58
<i>Section :</i>	Brechin Castle	<i>Date Reaped :</i>	Plants 1/5/59
<i>Field :</i>	Estate 36		1st Ratoons 3/5/60
<i>Design :</i>	2 x 3 x 4 (NPK) Factorial		2nd Ratoons 13/3/61
<i>Plot Size :</i>	1/40th acre		3rd Ratoons 27/4/62
<i>Soil Type :</i>	Couva Loam & Clay		
<i>Variety :</i>	B 41227		

Results (TS/A)

Analysis of Variance

Source of Variation	Degrees of Freedom	'F' Ratio to Error
Nitrogen	1	< 1
Phosphorus	2	< 1
Potassium	3	4.16 n.s.
Other Interaction : n.s.		

n.s. = Not Significant

Main Treatment Effects

Sulphate of Ammonia (21% N)		Triple Super Phosphate (40% P ₂ O ₅)		Muriate of Potash (60% K ₂ O)	
Treatment	Yield (TS/A)	Treatment	Yield (TS/A)	Treatment	Yield (TS/A)
4 cwt/acre	3.57	0 cwt/acre	3.43	0 cwt/acre	2.98
6 cwt/acre	3.42	2 cwt/acre	3.48	2 cwt/acre	3.55
		4 cwt/acre	3.59	4 cwt/acre	3.83
				6 cwt/acre	3.62

Appendix 35.

Fertilizer Trial

Estate :	Brechin Castle	Date Planted :	30/6/59
Section :	Brechin Castle	Date Reaped :	Plants 18/5/60
Field :	Estate 106	1st Ratoons	12/5/61
Design :	2 x 3 x 4 (NPK) Factorial	2nd Ratoons	25/4/62
Plot Size :	1/40th acre		
Soil Type :	Sevilla Clay		
Variety :	B 41227		

Results (TS/A)

Analysis of Variance

Source of Variation	Degrees of Freedom	'F' Ratio to Error
Nitrogen	1	< 1
Phosphorus	2	1.38 n.s.
Potassium	3	2.08 n.s.
Interaction: P x K	6	< 1
Other Interaction: n.s.		

n.s. = Not Significant

Main Treatment Effects

Sulphate of Ammonia (21% N)		Triple Super Phosphate (40% P ₂ O ₅)		Muriate of Potash (60% K ₂ O)	
Treatment	Yield (TS/A)	Treatment	Yield (TS/A)	Treatment	Yield (TS/A)
2 cwt/acre	3.48	0 cwt/acre	3.63	0 cwt/acre	2.96
4 cwt/acre	3.51	2 cwt/acre	3.68	2 cwt/acre	3.50
		4 Cwt/acre	3.19	3 cwt/acre	3.71
				4 cwt/acre	3.82

Appendix 36.

Fertilizer Trial

Estate : Brechin Castle Date Planted : 18/7/59
 Section : Montserrat Date Reaped : Plants 23/4/60
 Field : C W 11 1st Ratoons 22/2/61 *
 Design : 2 x 4 x 3 (NPK) Factorial 2nd Ratoons 9/2/62
 Plot Size : 1/40th acre * Field burnt accidentally
 Soil Type : Talparo Clay
 Variety : B 41227

Results (TS/A)

Analysis of Variance

Source of Variation	Degrees of Freedom	'F' Ratio to Error
Nitrogen	1	10.18 x
Phosphorus	3	16.14 xx
Potassium	2	12.19 xx
Interaction: N K	2	17.79 xx
Interaction: P K	6	4.11 x

x = Significant at 5% level
 xx = Significant at 1% level
 n.s. = Not Significant

Main Treatment Effects

Sulphate of Ammonia (21% N)		Triple Super Phosphate (40% P ₂ O ₅)		Muriate of Potash (60% K ₂ O)	
Treatment	Yield (TS/A)	Treatment	Yield (TS/A)	Treatment	Yield (TS/A)
2 cwt/acre	3.66	0 cwt/acre	3.31	0 cwt/acre	3.42
4 cwt/acre	3.86	2 cwt/acre	3.59	2 cwt/acre	3.79
		4 cwt/acre	3.82	4 cwt/acre	3.94
		6 cwt/acre	4.15		

L.S.D. @ p 0.05 = 0.21

L.S.D. @ p 0.01 = 0.31

L.S.D. @ p 0.05 = 0.30

L.S.D. @ p 0.01 = 0.45

L.S.D. @ p 0.05 = 0.26

L.S.D. @ p 0.01 = 0.38

Appendix 37.

Fertilizer Trial

<i>Estate :</i>	Waterloo	<i>Date Planted :</i>	30/5/59
<i>Section :</i>	Waterloo	<i>Date Reaped :</i>	Plants 20/5/60
<i>Field :</i>	12 Woodland		1st Ratoons 20/4/61
<i>Design :</i>	3 x 3 x 3 Factorial		2nd Ratoons 16/1/62
<i>Plot Size :</i>	1/40th acre		
<i>Soil Type :</i>	Waterloo Loam & Clay		
<i>Variety :</i>	B 41227		

Results (TS/A)

Analysis of Variance

Source of Variation	Degrees of Freedom	'F' Ratio to Error
Nitrogen	2	12.15 xx
Phosphorus	2	1.08 n.s.
Potassium	2	5.82 x
Interaction	n.s.	

x = Significant at 5%
xx = Significant at 1%
n.s. = Not Significant

Main Treatment Effects

Sulphate of Ammonia (21% N)		Triple Super Phosphate (40% P ₂ O ₅)		Muriate of Potash (60% K ₂ O)	
Treatment	Yield (TS/A)	Treatment	Yield (TS/A)	Treatment	Yield (TS/A)
2 cwt/acre	1.21	0 cwt/acre	1.54	0 cwt/acre	1.26
4 cwt/acre	1.46	2 cwt/acre	1.49	2 cwt/acre	1.56
6 cwt/acre	1.77	4 cwt/acre	1.40	4 cwt/acre	1.62

L.S.D. @ 0.05 = 0.24

L.S.D. @ 0.01 = 0.33

Appendix 38.

Fertilizer Trial

Estate :	Woodford Lodge	Date Planted :	13/6/59
Section :	Felicite	Date Reaped :	Plants 5/5/60
Field :	3 E 1	1st Ratoons	21/4/61
Design :	3 x 3 x 3 Factorial	2nd Ratoons	3/2/62
Plot Size :	1/40th acre		
Soil Type :	Bejucal V.H. Clay		
Variety :	B 41227		

Results (TS/A)

Analysis of Variance

Source of Variation	Degrees of Freedom	'F' Ratio to Error
Nitrogen	2	5.07 x
Phosphorus	2	n.s.
Potassium	2	n.s.
Interaction PK (Linear)	1	9.51 xx
Other Interaction	n.s.	

x = Significant at 5% level

xx = Significant at 1%

n.s. = Not Significant

Main Treatment Effects

Sulphate of Ammonia (21% N)		Triple Super Phosphate (40% P ₂ O ₅)		Muriate of Potash (60% K ₂ O)	
Treatment	Yield (TS/A)	Treatment	Yield (TS/A)	Treatment	Yield (TS/A)
2 cwt/acre	1.10	0 cwt/acre	1.28	0 cwt/acre	1.19
4 cwt/acre	1.36	4 cwt/acre	1.23	2 cwt/acre	1.27
6 cwt/acre	1.34	2 cwt/acre	1.29	4 cwt/acre	1.34
L.S.D. @ 0.01 = 0.30					
L.S.D. @ 0.05 = 0.20					

Appendix 39.

Fertilizer Trial

Estate :	Brechin Castle	Date Planted :	5/7/58
Section :	Brechin Castle	Date Reaped :	Plants 2/5/59
Field :	Estate 11	1st Ratoons	23/5/60
Design :	2 x 3 x 4 (NPK) Factorial	2nd Ratoons	1/6/61
Plot Size :	1/40th acre	3rd Ratoons	29/5/62
Soil Type :	Sevilla Clay		
Variety :	B 41227		

Results (TS/A)

Analysis of Variance

Source of Variation	Degrees of Freedom	'F' Ratio to Error
Nitrogen	1	< 1
Phosphorus	2	< 1
Potassium	3	1.01 n.s.
Interaction: N K	1	5.30 x

n.s. = Not Significant
x = Significant at 5% level

Main Treatment Effects

Sulphate of Ammonia (21 % N)		Triple Super Phosphate (40% P ₂ O ₅)		Muriate of Potash (60% K ₂ O)	
Treatment	Yield (TS/A)	Treatment	Yield (TS/A)	Treatment	Yield (TS/A)
4 cwt/acre	4.34	0 cwt/acre	4.46	0 cwt/acre	4.33
6 cwt/acre	4.30	2 cwt/acre	4.26	2 cwt/acre	4.10
		4 cwt/acre	4.22	4 cwt/acre	4.60
				6 cwt/acre	4.23

Appendix 40.

Fertilizer Trial

<i>Estate :</i>	Waterloo	<i>Date Planted :</i>	28/6/59
<i>Section :</i>	Mc Bean	<i>Date Reaped :</i>	Plants 9/5/60
<i>Field :</i>	Est. 12		1st Ratoons 11/4/61
<i>Design :</i>	3 x 3 x 3 (NPK) Factorial		2nd Ratoons 2/4/62
<i>Plot Size :</i>	1/40 Acre		
<i>Soil Type :</i>	Mc Bean sand and loam		
<i>Variety :</i>	B 41227		

Results (TS/A)

Analysis of Variance

Source of Variation	Degrees of Freedom	'F' Ratio to Error
Nitrogen	2	< 1
Phosphorus	2	< 1
Potassium	2	3.66 n.s.
Interactions : n.s.		

n.s. = Not Significant

Main Treatment Effects

Sulphate of Ammonia (21% N)		Triple Super Phosphate (40% P ₂ O ₅)		Muriate of Potash (60% K ₂ O)	
Treatment	Yield (TS/A)	Treatment	Yield (TS/A)	Treatment	Yield (TS/A)
2 cwt/acre	3.72	0 cwt/acre	3.90	0 cwt/acre	3.44
4 cwt/acre	4.15	2 cwt/acre	3.89	2 cwt/acre	4.06
6 cwt/acre	4.02	4 cwt/acre	4.10	4 cwt/acre	4.38

Appendix 41.

Fertilizer Trial

<i>Estate :</i>	Caroni	<i>Date Planted:</i>	20/6/59
<i>Section:</i>	Wilderness	<i>Date Reaped:</i>	Plants 11/4/60
<i>Field:</i>	W. 18		1st Ratoons 3/3/61
<i>Design:</i>	3 x 3 x 3 (NPK) Factorial		2nd Ratoons 12/4/62
<i>Plot Size:</i>	1/40 Acre		
<i>Soil Type:</i>	Cunupia medium clay		
<i>Variety :</i>	B 41227		

Results (TS/A)

Source of Variation	Degrees of Freedom	'F' Ratio to Error
Nitrogen	2	3.01 n.s.
Phosphorus	2	< 1
Potassium	2	3.62 n.s.
Interactions : n.s.		

n.s. = Not Significant

Main Treatment Effects

Sulphate of Ammonia (21% N)		Triple Super Phosphate (40% P ₂ O ₅)		Muriate of Potash (60% K ₂ O)	
Treatment	Yield (TS/A)	Treatment	Yield (TS/A)	Treatment	Yield (TS/A)
2 cwt/acre	2.97	0 cwt/acre	3.27	0 cwt/acre	2.99
4 cwt/acre	3.32	2 cwt/acre	3.24	2 cwt/acre	3.18
6 cwt/acre	3.31	4 cwt/acre	3.08	4 cwt/acre	3.43

Appendix 42.

Fertilizer Trial

Estate :	Waterloo	Date Planted :	30/6/60
Section :	Wyaby	Date Reaped :	9/5/61
Field :	CW. 11	1st Ratoons	29/3/62
Design :	3 x 3 x 3 (NPK) Factorial		
Plot Size :	1/40 Acre		
Soil Type :	Freeport Clay		
Variety :	B 41227		

Results (TS/A)

Analysis of Variance

Source of Variation	Degrees of Freedom	'F' Ratio to Error
Nitrogen	2	6.63 xx
Phosphorus	2	2.51 n.s.
Potassium	2	1.06 n.s.
Interaction: NK	1	5.59 x

n.s. = Not Significant
xx = Significant at 1% level
x = Significant at 5% level

Main Treatment Effects

Sulphate of Ammonia (21% N)		Triple Super Phosphate (40% P ₂ O ₅)		Muriate of Potash (60% K ₂ O)	
Treatment	Yield (TS/A)	Treatment	Yield (TS/A)	Treatment	Yield (TS/A)
2 cwt/acre	2.35	0 cwt/acre	2.69	0 cwt/acre	2.54
4 cwt/acre	2.73	2 cwt/acre	2.88	2 cwt/acre	2.76
6 cwt/acre	2.98	4 cwt/acre	2.76	4 cwt/acre	2.77

L.S.D. @ 0.05 = 0.38

L.S.D. @ 0.01 = 0.52

Fertilizer Trial

Estate : Woodford Lodge Date Planted : 24/6/60
 Section : Felicite Date Reaped : Plants 11/5/61
 Field : 4W. 4 1st Ratoons — 15/2/62
 Design : 4 x 5 Randomised Blocks
 Plot Size : 0.45 Acre
 Soil Type : Bejucal Very Heavy Clay
 Variety : B 41227

Results :

Treatments			Yield			Pre-processing cost per ton sugar R (C/Y + H)
Sulphate of Ammonia	Super Phosphate	Muriate of Potash	1st Ratoons		Total yield TS/A for 2 crops Plants & 1st Rats.	
21% N	40% P2O5	60% K2O	TC/A	TC/TS	TS/A	
4 cwt/acre	0 cwt/acre	2 cwt/acre	17.35	12.60	1.38	\$264.85
4 cwt/acre	2 cwt/acre	2 cwt/acre	18.66	11.93	1.58	\$239.32
2 cwt/acre	4 cwt/acre	2 cwt/acre	16.08	10.96	1.47	\$242.54
2 cwt/acre	0 cwt/acre	0 cwt/acre	15.35	11.94	1.30	\$272.71
Differences required for statistical significance			2.90	1.19	1.09	
			4.06	1.69	1.53	

Treatment	Additional Cost of fertilizer over present practice	Pre-processing Cost	Total Cost
4 — 0 — 2	—	\$264.85	\$264.85
4 — 2 — 2	\$13.36	\$239.32	\$252.68*
2 — 4 — 2	\$18.80	\$242.54	\$261.34
2 — 0 — 0	\$ 7.92	\$272.71	\$264.79

* The most economical treatment is 4 — 0 — 2.

Fertilizer Trial

Estate : Woodford Lodge
 Date Planted : 24/6/60
 Section : Felicite
 Date Reaped : Plants — 19/5/61
 Field : Est. 45
 1st Ratoons — 6/4/62
 Design : 4 x 4 Randomised Blocks
 Plot Size : 0.49 Acre
 Soil Type : Sevilla Clay
 Variety : B 41227

Results :

Treatments			Yield			Total yield TS/A for 2 crops Plants & 1st Rats.	Pre- processing cost per ton sugar R (C/Y + H)
Sulphate of Ammonia	Super Phosphate	Muriate of Potash	1st Ratoons				
21% N	40% P2O5	60% K2O	TC/A	TC/TS	TS/A		
4 cwt/acre	0 cwt/acre	2 cwt/acre	27.21	8.53	3.25	6.61	\$188.00
4 cwt/acre	2 cwt/acre	3 cwt/acre	29.70	8.41	3.46	6.68	\$128.50
4 cwt/acre	2 cwt/acre	2 cwt/acre	27.12	8.35	3.24	6.48	\$134.02
2 cwt/acre	0 cwt/acre	2 cwt/acre	28.55	8.41	3.21	6.25	\$131.28
Differences required for statistical significance			5.46	0.44	0.70		
			7.85	0.64	1.00		

Treatment	Additional Cost of fertilizer over present practice	Pre-processing Cost	Total Cost
4 — 0 — 2	—	\$188.00	\$188.00
4 — 2 — 3	\$17.91	\$128.50	\$146.41
4 — 2 — 2	\$13.36	\$134.02	\$147.38
2 — 0 — 2	— \$ 7.92	\$131.28	\$123.36*

* The most economical treatment is 2 — 0 — 2.

Fertilizer Trial

Estate : Brechin Castle
Section : Perseverance
Field : 2 Un. Savannah
Design : 4 x 5 Randomised Blocks
Plot Size : 1/4 Acre
Soil Type : Waterloo Loam and Clay
Variety : B 41227

Date Planted : 28/6/60
Date Reaped : Plants — 8/5/61
 1st Ratons — 13/4/62

Results :

Treatments			Yield			Total yield TS/A for 2 crops Plants & 1st Rats.	Pre- processing cost per ton sugar R(C/Y + H)
Sulphate of Ammonia	Super Phosphate	Muriate of Potash	1st Ratoons				
21% N	40% P2O5	60% K2O	1C/A	TC/TS	TS/A		
4 cwt/acre	0 cwt/acre	2 cwt/acre	23.97	8.23	2.92	5.38	\$141.64
6 cwt/acre	2 cwt/acre	4 cwt/acre	28.32	8.65	3.28	6.27	\$135.55
2 cwt/acre	2 cwt/acre	2 cwt/acre	23.44	8.21	2.87	5.42	\$143.18
2 cwt/acre	0 cwt/acre	4 cwt/acre	22.36	7.86	2.85	5.36	\$140.93
Differences required for statistical significance			6.00	0.47	0.58		
			8.41	0.66	0.82		

Treatment	Additional Cost of fertilizer over present practice	Pre-processing Cost	Total Cost
4 — 0 — 2	—	\$141.64	\$141.64*
6 — 2 — 4	\$30.38	\$135.55	\$165.93
2 — 2 — 2	\$ 5.44	\$143.18	\$148.62
2 — 0 — 4	\$ 1.18	\$140.93	\$142.11

* The most economical treatment is 4 — 0 — 2.

Fertilizer Trial

Estate : Caroni
Section : Curepe
Field : F. 170
Design : 4 x 5 Randomised Blocks
Plot Size : 1/4 Acre
Soil Type : Frederick Very Heavy Clay
Variety : B 41227

Date Planted : 27/6/60
Date Reaped : Plants — 10/5/61
 1st Ratoons — 19/4/62

Results :

Treatments		Yield			Total yield TS/A for 2 crops Plants & 1st Rats.	Pre-processing cost per ton sugar R (C/Y + H)
Sulphate of Ammonia	Super Phosphate	Muriate of Potash	1st Ratoons	TS/A		
21% N	40% P ₂ O ₅	60% K ₂ O	TC/A	TC/TS		
4 cwt/acre	0 cwt/acre	2 cwt/acre	34.46	7.99	4.32	\$113.38
2 cwt/acre	2 cwt/acre	4 cwt/acre	33.48	8.11	4.13	\$116.70
4 cwt/acre	2 cwt/acre	4 cwt/acre	35.60	8.09	4.40	\$112.77
4 cwt/acre	4 cwt/acre	4 cwt/acre	34.00	8.01	4.25	\$114.22
Differences required for statistical significance		5%	2.67	0.31	0.39	
		1%	3.75	0.44	0.55	

Treatment	Additional Cost of fertilizer over present practice	Pre-processing Cost	Total Cost
4 — 0 — 2	—	\$113.38	\$113.38*
2 — 2 — 4	\$14.54	\$116.70	\$131.24
4 — 2 — 4	\$22.46	\$112.77	\$135.23
4 — 4 — 4	\$35.82	\$114.27	\$150.09

* The most economical treatment is 4 — 0 — 2.

Fertilizer Trial

Estate : Caroni
 Section : Wilderness
 Field : W. 10
 Design : 4 x 5 Randomised Blocks
 Plot Size : 1/3 Acre
 Soil Type : Bejucal Very Heavy Clay
 Variety : B 41227

Date Planted : 24/6/60
 Date Reaped : Plants — 12/4/61
 1st Ratoons — 16/4/62

Results :

Treatments			Yield			Total yield TS/A for 2 crops. Plants & 1st Rats.	Pre- processing cost per ton sugar R (C/Y + H)
Sulphate of Ammonia 21% N 4 cwt/acre 6 cwt/acre 4 cwt/acre 6 cwt/acre	Super Phosphate 40% P2O5 0 cwt/acre 4 cwt/acre 2 cwt/acre 2 cwt/acre	Muriate of Potash 60% K2O 2 cwt/acre 4 cwt/acre 4 cwt/acre 4 cwt/acre	1st Ratoons				
			TC/A	TC/TS	TS/A		
			42.76	8.54	5.02		
			45.36	8.42	5.39		
			45.92	8.35	5.49		
			45.68	8.41	5.42		
Differences required for statistical significance			3.98	0.22	0.49		
			3.58	0.31	0.69		

Treatment	Additional Cost of fertilizer over present practice	Pre-processing Cost	Total Cost
4 — 0 — 2	—	\$109.39	\$109.39*
6 — 4 — 4	\$43.74	\$105.17	\$148.91
4 — 2 — 4	\$22.46	\$103.79	\$126.25
6 — 2 — 4	\$30.38	\$104.70	\$135.08

* The most economical treatment is 4 — 0 — 2.

Fertilizer Trial

Estate : Waterloo
Section : Mc Bean
Field : Estate 21A
Design : 4 x 5 Randomised Blocks
Plot Size : 1/4 Acre
Soil Type : Mc Bean Sand and Loam
Variety : B 41227

Date Planted : 28/6/60
Date Reaped : Plants — 25/5/61
 1st Ratoons — 6/6/62

Results :

Treatments		Muriate of Potash		Yield		Total yield TS/A for 2 crops Plants & 1st Rats.	Pre-processing cost per ton sugar R (C/Y + H)
Sulphate of Ammonia	Super Phosphate	40% P ₂ O ₅	60% K ₂ O	TC/A	TC/TS		
2 1% N	40% P ₂ O ₅	0 cwt/acre	2 cwt/acre	37.78	8.75	4.32	\$118.56
4 cwt/acre	0 cwt/acre	2 cwt/acre	4 cwt/acre	38.74	9.38	4.14	\$125.69
6 cwt/acre	2 cwt/acre	2 cwt/acre	4 cwt/acre	40.28	8.81	4.59	\$115.94
4 cwt/acre	2 cwt/acre	2 cwt/acre	4 cwt/acre	38.72	8.71	4.74	\$116.71
2 cwt/acre	2 cwt/acre	2 cwt/acre	4 cwt/acre	4.87	0.27	0.61	
Differences required for statistical significance		5%	1%	6.83	0.38	0.85	

Treatment	Additional Cost of fertilizer over present practice	Pre-processing Cost	Total Cost
4 — 0 — 2	—	\$118.56	\$118.56*
6 — 2 — 4	\$30.38	\$125.69	\$156.07
4 — 2 — 4	\$22.46	\$115.94	\$138.40
2 — 2 — 4	\$14.54	\$116.71	\$131.25

* The most economical treatment is 4 — 0 — 2.

Fertilizer Trial

Estate: Waterloo
Section: Wyaby
Field: Congo Wood 2
Design: 4 x 5 Randomised Blocks
Plot Size: 1/4 Acre
Soil Type: Freeport Clay
Variety: B 41227
Date Planted: 26/6/61
Date Reaped: Plants — 11/6/62

Results:

Treatments			Yield			Pre-processing cost per ton sugar R (C/Y + H)
Sulphate of Ammonia	Triple Super Phosphate	Muriate of Potash	Plants			
21 % N	40 % P2O5	60 % K2O	FC/A	TC/TS	TS/A	
4 cwt/acre	0 cwt/acre	2 cwt/acre	23.04	9.92	2.33	\$174.79
4 cwt/acre	2 cwt/acre	2 cwt/acre	25.92	10.28	2.54	\$169.21
6 cwt/acre	2 cwt/acre	2 cwt/acre	26.52	10.42	2.55	\$169.33
4 cwt/acre	2 cwt/acre	4 cwt/acre	24.68	10.43	2.37	\$176.48
Differences required for statistical significance			2.49	0.59	0.34	
			3.48	0.82	0.48	

Treatment	Additional Cost of fertilizer over present practice	Pre-processing Cost	Total Cost
4 — 0 — 2	—	\$174.79	\$174.79*
4 — 2 — 2	\$13.36	\$169.21	\$182.57
6 — 2 — 2	\$21.28	\$169.33	\$190.61
4 — 2 — 4	\$22.46	\$176.48	\$198.94

* The most economical treatment is 4 — 0 — 2.

Fertilizer Trial

Estate: Brechin Castle *Date Planted:* 30/6/60
Section: Brechin Castle *Date Reaped:* Plants 24/6/61
Field: Estate 34 1st Ratoons 9/2/62
Design: 4 x 5 Randomised Blocks
Plot Size: 1/5 Acre
Soil Type: Couva loam and clay
Variety: B 41227

Results:

Treatments			Yield		Total yield TS/A for 2 crops Plants & 1st Rats.	Pre- processing cost per ton sugar R (C/Y + H)
Sulphate of Ammonia	Super Phosphate	Muriate of Potash	TC/A	TC/TS		
21% N	40% P2O5	60% K2O				
4 cwt/acre	0 cwt/acre	2 cwt/acre	33.28	11.85	6.47	\$170.76
4 cwt/acre	4 cwt/acre	4 cwt/acre	34.30	12.31	6.70	\$174.80
4 cwt/acre	0 cwt/acre	4 cwt/acre	33.36	12.58	6.50	\$181.03
4 cwt/acre	4 cwt/acre	3 cwt/acre	33.60	12.15	6.54	\$174.23
Differences required for statistical significance			1.96	1.00		
			2.75	1.41		

Treatment		Additional Cost of fertilizer over present practice	Pre-processing Cost	Total Cost
4 — 0 — 2		—	\$170.76	\$170.76*
4 — 4 — 4		\$25.82	\$174.80	\$200.62
4 — 0 — 4		\$ 9.10	\$181.03	\$190.13
4 — 4 — 3		\$31.27	\$174.23	\$205.50

* The most economical treatment is 4 — 0 — 2.

Fertilizer Trial

Estate: Brechin Castle
Section: Perseverance
Field: F.H. 10
Design: 16 x 4 Randomised Blocks
Plot Size: 1/60th Acre
Soil Type: Waterloo loam and clay
Variety: B 41227

Date Reaped: Treatments were first applied to
 1st ratoons cane 17 days after
 reaping as plants
 1st Ratoons—21/1/61
 2nd Ratoons—1/2/62

Results:

Treatment	cwt/acre	Yield		Total yield TS/A for 2 crops 1st & 2nd Ratoons	Pre- processing cost per ton sugar R (C/Y + H)
		TC/A	TC/TS		
* 14/14/14	2	17.23	10.53	1.66	\$222.49
* 14/14/14	4	23.97	10.82	2.27	\$186.21
* 14/14/14	6	25.61	12.15	2.12	\$201.33
* 12/12/17/2	2	16.38	11.09	1.52	\$242.32
* 12/12/17/2	4	20.29	11.01	1.86	\$209.52
* 12/12/17/2	6	25.26	11.59	2.20	\$193.55
* 13/13/20	2	18.02	10.82	1.67	\$222.02
* 13/13/20	4	20.99	11.21	1.87	\$208.84
* 13/13/20	6	25.87	10.99	2.37	\$181.15
* 20/20/0	2	20.58	10.17	2.04	\$191.81
* 20/20/0	4	23.65	11.03	2.17	\$191.37
* 20/20/0	6	26.75	12.79	2.08	\$206.81
* Calnitro	2	20.16	11.24	1.82	\$214.68
* Calnitro	4	23.70	11.93	2.00	\$206.75
* Calnitro	6	27.12	12.05	2.31	\$193.40
Sulphate of Ammonia + Muriate of Potash	4) 1½)	22.38	10.19	2.16	\$182.60*
Differences required for statistical significance	5% 1%	3.06 4.09	1.97 2.63	0.41 0.55	

* These five fertilizers are produced by Hoechst — Germany.

Calnitro = Calcium Ammonium Nitrate

20.5% N

30.32% CaCO₃

5.6% MgCO₃

* The most economical treatment

Fertilizer Trial

Estate: Gordon
Section: Phoenix Park
Field: Px. 17E.
Design: 16 x 4 Randomised Blocks
Plot Size: 1/60th Acre
Soil Type: Sevilla series
Variety: B 41227

Date Planted: 13/7/60
Date Reaped: Plants — 24/2/61
 1st Ratoons — 11/1/62

Results:

Treatment		Yield			Total yield TS/A for 2 crops Plants & 1st Rats.	Pre- processing cost per ton sugar R(C/Y + H)
Formulation (NPK)		TC/A	TC/TS	TS/A		
* 14/14/14		32.21	12.41	2.60	4.48	\$181.81
* 14/14/14		34.29	12.42	2.77	4.75	\$176.64
* 14/14/14		38.59	13.19	2.94	5.26	\$177.00
* 12/12/17/2		33.09	12.25	2.73	4.83	\$177.01
* 12/12/17/2		35.31	12.52	2.82	4.86	\$175.28
* 12/12/17/2		37.14	12.67	2.93	4.96	\$173.07
* 13/13/20		34.23	12.87	2.65	4.67	\$182.88
* 13/13/20		37.78	12.78	2.97	5.18	\$173.17
* 13/13/20		35.15	12.28	2.87	5.01	\$172.29
* 20/20/0		31.75	13.03	2.44	4.33	\$192.32
* 20/20/0		32.13	11.89	2.73	4.80	\$174.43
* 20/20/0		37.17	13.38	2.79	4.92	\$182.77
Other Treatments						
Sulphate of Ammonia	Super Phosphate	Muriate of Potash				
	2	37.01	13.12	2.83	5.04	
	2	39.56	12.16	3.26	5.42	
	0	33.79	12.83	2.67	4.69	
	0	40.01	12.81	3.13	5.25	
Differences required for statistical significance		5.75 7.70	1.04 1.39	0.50 0.67		
					\$179.48	
					\$161.36	
					\$183.47	
					\$169.09*	

* These four fertilizers are produced by Hoechst — Germany.

* The most economical treatment is 4 — 0 — 2.

Fertilizer Trial

<i>Estate :</i>	Brechin Castle	<i>Date Planted :</i>	9/7/60
<i>Section :</i>	Brechin Castle	<i>Date Reaped :</i>	Plants 19/4/61
<i>Field :</i>	Camden 13	<i>1st Ratoons :</i>	3/2/62
<i>Design :</i>	8 x 5 Randomised Blocks		
<i>Plot Size :</i>	1/40th Acre		
<i>Soil Type :</i>	Couva loam and clay		
<i>Variety :</i>	B 41227		

Results :

Treatment	Yield		Total Yield (TS/A) for 2 crops Plants & 1st Rats.	Pre- processing cost per ton sugar R (C/Y + H)
	TC/A	TC/TS	TS/A	
4 cwt. Sulphate of Ammonia) +)	42.83	10.35	4.15	\$132.48*
2 cwt. Muriate of Potash)				
4 cwt. Sulphate of Ammonia) 4 cwt. Superphosphate) 4 cwt. Muriate of Potash)	43.81	10.19	4.29	\$129.21
* 15/15/15 — 300 lbs/acre	37.33	10.06	3.72	\$137.12
15/15/15 — 500 lbs/acre	35.53	9.59	3.91	\$133.78
13/13/20 — 300 lbs/acre	37.55	9.90	3.78	\$134.54
13/13/20 — 500 lbs/acre	36.76	9.85	3.72	\$135.24
Nitrophoska Grey — 300 lbs/acre	37.31	10.04	3.71	\$136.85
Nitrophoska Grey — 500 lbs/acre	36.82	10.34	3.53	\$141.86
statistical significance) 5% Differences required for) 1%	8.65 11.68	0.56 0.76	0.26 0.36	

* These three "complete" fertilizers "Nitrophoska Green, Red, and Grey" are produced by B.A.S.F. Germany.

* The most economical treatment is 4 — 0 — 2.

Fertilizer Trial

Estate: Brechin Castle. *Date Planted:* 25/6/60
Section: Perseverance *Date Reaped:* Plants 1/5/61
Field: 20 Acre *1st Ratoons:* 7/6/62
Design: 6 x 5 Randomised Blocks
Plot Size: 1/40th Acre
Soil Type: Waterloo loam and clay
Variety: B 41227

Results:

Treatments	Yield			Total Yield (TS/A) 2 crops Plants & 1st Ratoons	Pre- processing cost per ton sugar R (C/Y + H)
	TC/A	TC/TS	TS/A		
A. Urea 2 cwt/acre	31.82	8.56	3.82	6.66	\$126.17
B. Calcium Ammonia Nitrate 4 cwt/acre	28.65	8.78	3.28	6.47	\$136.79
C. Calnitro 4 cwt/acre	31.17	8.33	3.74	6.82	\$124.12
D. Calcium Nitrate 4 cwt/acre	29.31	9.39	3.19	6.33	\$144.51
E. Sulphate of Ammonia 4 cwts. (in one application)	33.04	7.97	4.14	7.27	\$115.25
F. Sulphate of Ammonia 4 cwts. (in two applications)	35.57	8.06	4.17	7.17	\$112.44
Differences required for	7.18	1.84	0.88		
statistical significance	5%	1.33	0.64		

B, C, D = The Nitrogenous fertilizers are produced by:

B = B.A.S.F.
 C = Hoechst
 D = Rhur-Stickstoff

Each one contains 20.5% N.

Price of Urea 2 cwts. = \$16.34

Price of Sulphate of Ammonia 4 cwts = \$15.84.

Appendix 55.

Fertilizer Trial

Estate: Waterloo
Section: Mc Bean
Field: Estate 15
Design: 3 x 5 Randomised Blocks
Plot Size: 1/40th Acre
Soil Type: Mc Bean Sand to Loam
Variety: B 41227
Date Planted: 23—24/6/61
Date Reaped: Plants 7/6/62

Results:

Treatments	Yield			Pre-processing cost per ton sugar R(C/Y + H)
	TC/A	TC/TS	TS/A	
A. Sulphate of Ammonia (21% N) 4 cwt/acre	21.47	10.14	2.11	\$186.37
B. Calcium Ammonium Nitrate (20.5% N) 4 cwt/acre	20.48	9.77	2.09	\$184.85
C. Urea (46% N) 2 cwt/acre	20.85	9.77	2.14	\$182.80
Differences required for statistical significance	6.61 4.54	1.45 1.00	0.40 0.27	

Appendix 56.

Fertilizer Trial

Estate: Caroni
Section: Curepe
Field: F. 143
Design: 3 x 5 Randomised Blocks
Plot Size: 1/40th Acre
Soil Type: Frederick V.H. Clay
Variety: B 41227

Date Planted: 30/6/61

Date Reaped: Plants 17/4/62

Results:

Treatment	Yield			Pre-processing cost per ton sugar R(C/Y + H)
	TC/A	TC/TS	TS/A	
A. Sulphate of Ammonia (21% N) 4 cwt/acre	12.17	8.29	1.47	\$223.17
B. Calcium Ammonium Nitrate (20.5% N) 4 cwt/acre	13.00	8.66	1.50	\$222.22
C. Urea (46% N) 2 cwt/acre	12.02	8.36	1.43	\$227.14
Differences required for	2.78	0.46	0.36	
statistical significance	1.91	0.32	0.24	

Appendix 57.

Fertilizer Trial

Estate : Caroni
 Date Planted : 24/6/61
 Section : Jerningham Junction
 Date Reaped : Plants 28/4/62
 Field : Monjaloux 28
 Design : 6 x 5 Randomised Blocks
 Plot Size : 1/40th Acre
 Soil Type : Piarco series
 Variety : B 41227

Results :

Treatment	Yield			Pre-processing cost per ton sugar R(C/Y + H)
	TC/A	TC/TS	TS/A	
A. 2 cwt. Superphosphate	30.95	7.56	4.09	\$113.02
*B. 2 cwt. Superphosphate	31.55	7.87	4.01	\$116.48
C. 3 cwt. Hyperphosphate	29.77	7.38	4.03	\$112.61
*D. 3 cwt. Hyperphosphate	28.93	7.53	3.85	\$116.72
E. 4 cwt. Superphosphate	31.60	8.08	3.93	\$119.50
F. 6 cwt. Hyperphosphate	29.48	7.48	3.95	\$114.74
Differences required for	6.05	0.60	0.89	
statistical significance	4.43	0.41	0.65	

* Treatments applied in plant year followed by same treatment for each ratoon crop.

Appendix 58.

Fertilizer Trial

Estate : Waterloo
 Section : Waterloo
 Field : Un. 27
 Design : 5 x 5 Latin Square
 Plot Size : 1/40th Acre
 Soil Type : Freeport Clay
 Variety : B 41227

Treatments were applied on
 1st Ratoons : 9/6/61
 Date Reaped : 1st Ratoons : 27/3/62

Results:

lbs. N/acre	Treatment		Yield			Pre-processing cost per ton sugar R(C/Y + H)
	* lbs. Amm. Phosphate per acre	lbs. K/acre (N.E.P.)	TC/A	TC/TS	TS/A	
94.08	0	134.4	24.10	8.29	2.90	\$142.26
95.61	7.2	134.4	21.37	8.22	2.62	\$151.49
97.14	14.4	134.4	21.88	8.41	2.61	\$152.81
98.66	21.6	134.4	22.10	8.07	2.72	\$145.74
100.19	28.8	134.4	22.87	8.09	2.82	\$143.11
Differences required for statistical significance			5.50	0.51	0.47	
			3.92	0.36	0.33	

* Ammonium Phosphate applied to the foliage.

Fertilizer Trial

Trial	Soil Type	1959			1960			1961			1962		
		TC/A	TC/TS	TS/A	TC/A	TC/TS	TS/A	TC/A	TC/TS	TS/A	TC/A	TC/TS	TS/A
Waterloo WL 12	Waterloo Loam & Clay		Planted		N(1%)	N(5%)	N(1%)	N(1%)	N.S.	N(1%)	N(1%) K(5%)	N(1%) NP(5%) NK(5%)	N(1%) K(5%)
B.C. Est. 36	Couva Loam & Clay	F.N.A.	F.N.A. 1 Year Plants	N.S.	N(1%)	N(5%)D	N.S.	N(1%)	K(5%)I PK(5%)I NP(1%)I	N(1%) K(5%) NP(5%)	N.S.	N.S.	N.S.
B.C. Est. 106	Sevilla Clay		Planted		N.S.	N(1%)D K(1%)I	N.S.	K(5%)	N(1%)D NP(1%)D	K(5%) PK(5%)	N.S.	N.S.	N.S.
Montserrat CW 11	Talparo Clay		Planted			1 Year Plants not harvested		P(1%) K(5%)	N.S.	P(1%) K(5%)	N(5%) P(5%) NK(5%)	N(5%) K(5%)	N(5%) P(1%) K(1%) NK(1%) PK(5%)
Felicite 3E. 1	Bejucal V.H. Clay		Planted		N(1%) NP(1%)	N.S.	NP(1%)	N(1%)	N(1%)D K(5%)I NP(5%)	N.S.	N(1%) PK(1%)	NP(5%)	N(5%) PK(1%)
B.C. Est. 11	Sevilla Clay	F.N.A.	F.N.A. 1 Year Plants	PK(5%)	PK(5%)	N.S.	N.S.	N.S.	N(5%)D P(5%)I K(5%)I NK(5%)D	K(5%)	NK(1%)	N.S.	NK(5%)
McBean Est. 12	McBean Sand		Planted		K(5%)	PK(5%)	N.S.	K(5%)	N(1%)D K(5%)I NK(5%)	N(5%) K(1%)	K(5%)	N.S.	N.S.
Wilderness W. 18	Cunupia Med. Clay		Planted		N,P,K(1%) NK, PK	NP(5%)D	N,P,K N'P', P'K' (1%)	N,P,K N'P' (1%) N'K'(5%)	N(5%)D K(1%)I	K(1%) N(5%)	K(1%) N(5%)	N(1%)	N.S.
Wyaby CW. 11	Freeport Clay	—	—	—		Planted		N(1%)	N(1%)D P(5%)I	N.S.	N(1%)	N.S.	N(1%) NK(5%)
Curepe F. 155	Frederick V.H. Clay	—	—	—	—	—	—		Planted		N.S.	P(5%) PK(5%)	N(5%) P(5%) NK(5%)

F.N.A. = Figures not available
D = Deterioration
I = Improvement
N.S. = Not significant.

Appendix 60.

Fertilizer Trial

Location: Williamsville N.G.6 Date Planted: 7/7/61
 Design: 6 x 4 Randomised Blocks Date Reaped: Young plants — 7/5/62
 Plot Size: 1/30th Acre
 Soil Type: Talparo Clay
 Variety: B 49119

Treatment per Acre		lbs. Active		TC/A	TC/TS	TS/A	Pre-processing cost per ton sugar R(C/Y + H)
		N2	P2O5				
1.	Control — Nil.	—	—	21.16	10.08	2.00	\$192.53
2.	448 lbs. Sulphate of Ammonia	94	—	21.46	4.89	2.17	\$181.78
3.	448 lbs. Sulphate of Ammonia + 336 lbs. Superphosphate	94	144.4	21.56	10.17	2.12	\$186.42
4.	522 lbs. Di-Mon (18:46:0)	94	240	20.25	9.74	2.08	\$185.55
5.	52½ lbs. Binape (16:20:0)	94	105	25.31	10.04	2.52	\$167.47
6.	376 lbs. Binario (25:10:0)	94	376	22.68	9.86	2.30	\$175.31
LSD P = 0.05				7.69	0.59	0.83	

Fertilizer Trial

Location: Petit Morne 20 *Date Planted:* 21/6/61
Design: 8 x 5 Randomised Blocks *Date Reaped:* Young plants — 23/4/62
Plot Size: 1/30th Acre
Soil Type: Princes Town Marl
Soil Analysis: N2 — 0.255%
 P2O5 — 0.0085%
 K2O — 0.051%
Variety: B 49119

Treatment per Acre	TC/A	TC/TS	TS/A	Pre-processing cost per ton sugar R(C/Y + H)
1. Control — Nil.	31.35	9.41	3.33	\$139.83
2. 4 cwt. Sulphate of Ammonia 8 weeks after planting	36.82	9.39	3.92	\$128.83
3. 3 cwt. 40% Superphosphate at banking + 4 cwt. Sulphate of Ammonia 8 weeks after planting	36.82	9.77	3.77	\$134.04
4. 3 cwt. 40% Superphosphate + 4 cwt. Sulphate of Ammonia both at 8 weeks after planting	39.15	9.67	4.05	\$128.90
5. 3 cwt. 40% Superphosphate at planting + 4 cwt. Sulphate of Ammonia 8 weeks after planting	33.82	9.37	3.61	\$133.99
6. 300 lbs. 15:15:15 at banking	34.42	9.92	3.47	\$140.57
7. 300 lbs. 15:15:15 at planting	36.00	9.42	3.82	\$130.66
8. 300 lbs. 15:15:15 8 weeks after planting	33.67	9.82	3.43	\$140.78
LSD P = 0.05	6.36	0.59	0.73	

Fertilizer Trial

Location: La Fortunee Her. 44 *Date Planted:* 28/6/61
Design: 8 x 6 Randomised Blocks *Date Reaped:* Young plants — 23/4/62
Plot Size: 1/30th Acre
Soil Type: Talparo Clay
Soil Analysis: N2 — 0.225%
 P2O5 — 0.003%
 K2O — 0.056%
Variety: B 49119

Treatment per acre	TC/A	TC/TS	TS/A	Pre-processing cost per ton sugar R(C/Y + H)
1. Control — Nil.	24.25	9.90	2.45	\$169.29
2. 4 cwts. Sulphate of Ammonia 8 weeks post planting	31.75	9.68	3.28	\$142.88
3. 3 cwts. 40% Superphosphate at banking + 4 cwts. Sulphate of Ammonia 8 weeks post planting	31.68	9.87	3.21	\$145.89
4. 3 cwts. 40% Superphosphate + 4 cwts. Sulphate of Ammonia both 8 weeks post planting	31.75	9.86	3.22	\$145.53
5. 3 cwts. 40% Superphosphate at planting + 4 cwts. Sulphate of Ammonia 8 weeks post planting	32.00	10.03	3.19	\$147.44
6. 300 lbs 15:15:15 at banking	28.44	9.91	2.87	\$154.99
7. 300 lbs. 15:15:15 at planting	27.38	9.81	2.79	\$156.65
8. 300 lbs. 15:15:15 8 weeks after planting	28.68	9.72	2.95	\$151.34
LSD P = 0.05	5.67	0.76	0.64	

Appendix 63.

Fertilizer Trial

Location: La Gloria L.R. 35 Date Planted: 13/7/61
 Design: 3 x 3 x 3 Factorial (NPK) Date Reaped: Young plants — 24/5/62
 Plot Size: 1/30th Acre
 Soil Type: Talparo Clay
 Variety: B 49119

Results (TS/A)

Analysis of Variance

Source of Variation	Degrees of Freedom	'F' Ratio to Error
Nitrogen	2	8.01 **
Phosphorus	2	1.22 n.s.
Potassium	2	3.77 *
Interaction P x K	1	14.56
Other Interactions : n.s.		

n.s. = Not significant

* = Significant at 5% level.

** = Significant at 1% level.

Main Treatment Effects

Sulphate of Ammonia (21% N)		Triple Superphosphate (40% P ₂ O ₅)		Muriate of Potash (60% K ₂ O)	
Treatment	Yield (TS/A)	Treatment	Yield (TS/A)	Treatment	Yield (TS/A)
2 cwt/acre	3.43	0 cwt/acre	3.21	0 cwt/acre	3.16
4 cwt/acre	3.59	2 cwt/acre	3.34	2 cwt/acre	3.27
6 cwt/acre	2.98	4 cwt/acre	3.45	4 cwt/acre	3.57

L.S.D. at p 0.05 = 0.33

L.S.D. at p 0.01 = 0.46

Appendix 64.

Fertilizer Trial

Location : La Gloria S.L. 4 (1) Date Planted : 3/8/60
 Design : 3 x 3 x 3 Factorial (NPK) Date Reaped : Young plants — 25/5/61
 Plot Size : 1/30th Acre 1st Ratoons — 18/4/62
 Soil Type : Talparo Clay
 Variety : B 49119

N.B. In this trial the fertilizers were applied first in the plant crop and were re-applied in the ratoon crop.

Results (TS/A)

Analysis of Variance

Source of Variation	Degrees of Freedom	'F' Ratio to Error
Nitrogen	2	13.03 **
Phosphorus	2	16.29 **
Potassium	2	3.10 n.s.
Interactions N x K	1	5.54 *
Other interactions	n.s.	

n.s. = Not significant

* = Significant at 5% level.

** = Significant at 1% level.

Main Treatment Effects

Sulphate of Ammonia (21% N)		Triple Superphosphate (40% P ₂ O ₅)		Muriate of Potash (60% K ₂ O)	
Treatment	Yield (TS/A)	Treatment	Yield (TS/A)	Treatment	Yield (TS/A)
2 cwt/acre	4.72	0 cwt/acre	4.90	0 cwt/acre	5.09
4 cwt/acre	5.43	2 cwt/acre	5.60	2 cwt/acre	5.05
6 cwt/acre	5.40	4 cwt/acre	5.26	4 cwt/acre	5.41

L.S.D. at p 0.05 = 0.34

L.S.D. at p 0.01 = 0.47

Appendix 65.

Fertilizer Trial

Location: La Gloria S.L. 4 (2) Date Planted: 3/8/60
 Design: 3 x 3 x 3 Factorial (NPK) Date Reaped: Young plants — 25/5/61
 Plot Size: 1/30th Acre 1st Ratoons — 18/4/62
 Soil Type: Talparo Clay
 Variety: B 49119

N.B. In this trial the fertilizers were applied first on the crop. As plant cane the entire area covered by the trial was treated with standard estate application of 4 cwts. Sulphate of Ammonia and 3 cwts. 40% Superphosphate per acre.

Results (TS/A)

Analysis of Variance

Source of Variation	Degrees of Freedom	'F' Ratio to Error
Nitrogen	2	3.98 *
Phosphorus	2	< 1 n.s.
Potassium	2	< 1 n.s.
Other interaction: n.s.		

n.s. = Not significant

* = Significant at 5% level.

Main Treatment Effects

Sulphate of Ammonia (21% N)		Triple Superphosphate (40% P ₂ O ₅)		Muriate of Potash (60% K ₂ O)	
Treatment	Yield (TS/A)	Treatment	Yield (TS/A)	Treatment	Yield (TS/A)
0 cwt/acre	4.49	0 cwt/acre	4.98	0 cwt/acre	5.06
3 cwt/acre	5.17	2 cwt/acre	4.94	2 cwt/acre	5.05
6 cwt/acre	5.36	4 cwt/acre	5.10	4 cwt/acre	4.90

L.S.D. at p 0.05 = 0.69

L.S.D. at p 0.01 = 0.95

Appendix 66.

Fertilizer Trial

Location: La Gloria S.L. 16 (1) *Date Planted:* 27/6/60
Design: 3 x 3 x 3 Factorial (NPK) *Date Reaped:* Young plants — 17/5/61
Plot Size: 1/30th Acre 1st Ratoons — 10/4/62
Soil Type: Green Clay
Variety: B 45224

N.B. In this trial the fertilizers were applied in the plant crop and were re-applied in the ratoon crop.

Results (TS/A)

Analysis of Variance

Source of Variation	Degrees of Freedom	'F' Ratio to Error
Nitrogen	2	2.35 n.s.
Phosphorus	2	14.02 **
Potassium	2	1.67 n.s.
Other interaction : n.s.		

n.s. = Not significant

** = Significant at 1% level.

Main Treatment Effects

Sulphate of Ammonia (21% N)		Triple Superphosphate (40% P ₂ O ₅)		Muriate of Potash (60% K ₂ O)	
Treatment	Yield (TS/A)	Treatment	Yield (TS/A)	Treatment	Yield (TS/A)
2 cwt/acre	4.53	0 cwt/acre	4.05	0 cwt/acre	4.54
4 cwt/acre	4.62	2 cwt/acre	4.98	2 cwt/acre	4.92
6 cwt/acre	4.97	4 cwt/acre	5.09	4 cwt/acre	4.66

L.S.D. at p 0.05 = 0.46

L.S.D. at p 0.01 = 0.64

Appendix 67.

Fertilizer Trial

Location: La Gloria S.L. 16 (2) *Date Planted:* 27/7/60
Design: 3 x 3 x 3 Factorial (NPK) *Date Reaped:* Young plants — 17/5/61
Plot Size: 1/30th Acre 1st Ratoons — 10/4/62
Soil Type: Green Clay
Variety: B 45224

N.B. In this trial the fertilizers were applied first in the ratoon crop. As plant cane the entire area covered by the trial had the standard application of 4 cwts. Sulphate of Ammonia and 3 cwts 40% Superphosphate per acre.

Results (TS/A)

Analysis of Variance

Source of Variation	Degrees of Freedom	'F' Ratio to Error
Nitrogen	2	2.50 n.s.
Phosphorus	2	1.75 n.s.
Potassium	2	1 n.s.
Other interaction : n.s.		

n.s. = Not significant

Main Treatment Effects

Sulphate of Ammonia (21% N)		Triple Superphosphate (40% P ₂ O ₅)		Muriate of Potash (60% K ₂ O)	
Treatment	Yield (TS/A)	Treatment	Yield (TS/A)	Treatment	Yield (TS/A)
0 cwt/acre	4.49	0 cwt/acre	4.51	0 cwt/acre	4.66
3 cwt/acre	4.70	2 cwt/acre	4.76	2 cwt/acre	4.69
6 cwt/acre	4.81	4 cwt/acre	4.72	4 cwt/acre	4.64

L.S.D. at p 0.05 = 0.31

L.S.D. at p 0.01 = 0.42

Appendix 68.

Fertilizer Trial

Location: Petit Morne C. 29/31/32 *Date Planted:* 23/7/60

Design: 8 x 5 Randomised Blocks *Date Reaped:* Young plants — 30/5/61

Plot Size: 1/30th Acre 1st Ratoons — 15/3/62

Soil Type: Alluvial

Soil Analysis: P2O5 — 0.0036%
N2 — 0.222%
K2O — 0.027%

Variety: B 50112

Treatment per acre	TC/A	TC/TS	TS/A	Pre-processing cost per ton sugar R(C/Y + H)
1. Control — nil.	39.00	12.30	3.17	\$164.20
2. 4 cwts. Sulphate of Ammonia	38.10	11.55	3.30	\$155.93
3. 6 cwts. Sulphate of Ammonia	36.37	12.94	2.81	\$178.57
4. 8 cwts. Sulphate of Ammonia	35.62	13.00	2.74	\$181.22
5. 204 lbs. Urea (equivalent to '2' in nitrogen)	38.55	11.58	3.33	\$155.51
6. 307 lbs. Urea (equivalent to '3' in nitrogen)	37.35	12.37	3.02	\$168.60
7. 409 lbs. Urea (equivalent to '4' in nitrogen)	38.77	11.37	3.41	\$152.24
8. 6 cwts. Sulphate of Ammonia + 2 cwts. Muriate of Potash	37.42	11.59	3.23	\$157.74
LSD P = 0.05	6.93	3.16	0.95	

Fertilizer Trial

Location: Petit Morne 44 *Date Planted:* 4/7/60
Design: 8 x 5 Randomised Blocks *Date Reaped:* Young plants — 16/5/61
Plot Size: 1/30th Acre 1st Ratoons — 15/2/62
Soil Type: Princes Town Marl
Variety: B 37172

Treatment per acre	TC/A	TC/TS	TS/A	Pre-processing cost per ton sugar R (C/Y + H)
1. Nil.	28.65	8.76	3.27	\$136.48
2. Nil.	31.35	8.91	3.52	\$131.87
3. 4 cwt. Sulphate of Ammonia	31.50	8.95	3.52	\$132.64
4. 6 cwt. Sulphate of Ammonia	31.05	9.00	3.45	\$134.37
5. 8 cwt. Sulphate of Ammonia	31.50	8.95	3.52	\$132.64
6. 204 lbs. Urea (equivalent to '3' in nitrogen)	31.80	8.96	3.55	\$132.16
7. 307 lbs. Urea (equivalent to '4' in nitrogen)	28.95	8.67	3.34	\$134.30
8. 409 lbs. Urea (equivalent to '5' in nitrogen)	29.10	8.87	3.28	\$137.40
LSD P = 0.05	15.89	0.45	1.79	

Fertilizer Trial

Location: Picton 51
 Design: 8 x 5 Randomised Blocks
 Plot Size: 1/30th Acre
 Soil Type: Talparo Clay
 Variety: B 45224

Date Planted: 17/6/60
 Date Reaped: Young plants — 29/4/61
 1st Ratoons — 19/3/62

Treatment per acre	TC/A	TC/TS	TS/A	Pre-processing cost per ton sugar R(C/Y + H)
1. Control — nil.	30.30	10.48	2.89	\$158.46
2. Control — nil.	27.38	10.41	2.63	\$166.25
3. 4 cwts. Sulphate of Ammonia	33.23	10.42	3.19	\$150.26
4. 6 cwts. Sulphate of Ammonia	38.25	10.04	3.81	\$135.24
5. 8 cwts. Sulphate of Ammonia	36.90	11.18	3.30	\$153.17
6. 204 lbs. Urea (equivalent to '3' in nitrogen)	35.78	10.34	3.46	\$143.82
7. 307 lbs. Urea (equivalent to '4' in nitrogen)	35.40	10.09	3.51	\$141.06
8. 409 lbs. Urea (equivalent to '5' in nitrogen)	35.33	10.80	3.27	\$151.09
LSD P = 0.05	8.46	1.35	0.83	

Fertilizer Trial

Location:

Design:

Plot Size:

Soil Type:

Soil Analysis:

Williamsville B.I. 55

10 x 4 Randomised Blocks

1/30th Acre

Talparo Clay

P205 — 0.0035%
K20 — 0.0195%
Lime requirement 18.61 tons

Date Planted:

Date Reaped:

1st Ratoons —

2nd Ratoons —

24/6/59

Young plants — 8/6/60

6/4/61

25/1/62

Treatment per acre	lbs. active per acre			TC/A	TC/TS	TS/A	Pre-processing cost per ton sugar R(C/Y + H)
	N2	P2O5	K2O				
1. Control —nil	—	—	—	28.50	11.49	2.48	\$179.47
2. 4 cwts. Sulphate of Ammonia	94	—	—	30.57	12.08	2.53	\$181.80
3. 6 cwts. Sulphate of Ammonia	141	—	—	30.38	11.34	2.68	\$171.23
4. 8 cwts. Sulphate of Ammonia	128	—	—	27.94	11.69	2.39	\$184.59
5. 6 cwts. Sulphate of Ammonia + 3 cwts. Superphosphate	141	134	—	35.06	11.69	3.00	\$164.24
6. 8 cwts. Sulphate of Ammonia + 3 cwts. Superphosphate	188	134	—	29.63	11.71	2.53	\$179.16
7. 6 cwts. Sulphate of Ammonia + 3 cwts. Superphosphate + 2 cwts. Muriate of Potash	141	134	134	31.70	11.28	2.81	\$166.61
8. 8 cwts. Sulphate of Ammonia + 3 cwts. Superphosphate + 2 cwts. Muriate of Potash	188	134	134	26.45	12.36	2.14	\$201.09
9. 700 lbs. Ammo-phos-Ko (10:20:20) + 3 cwts. Sulphate of Ammonia 8 weeks later	141	140	140	27.38	12.22	2.24	\$195.15
10. 1100 lbs. Ammo-phos-Ko (13:13:13)	143	143	143	29.82	12.17	2.45	\$185.59
LSD P = 0.05				15.7	2.24	1.43	

Fertilizer Trial

Location: Petit Morne 42 *Date Planted:* 25/6/59
Design: 9 x 4 Randomised Blocks *Date Reaped:* Young plants — 4/6/60
Plot Size: 1/30th Acre 1st Ratoons — 15/2/61
Soil Type: Princes Town Marl 2nd Ratoons — 7/2/62
Soil Analysis: K20 — 0.029%
 Free lime present
Variety: B 4847

Treatment per acre	lbs. active per acre			TC/A	TC/TS	TS/A	Pre-processing cost per ton sugar R(C/Y + H)
	N2	P2O5	K2O				
1. Control —nil	—	—	—	41.81	11.18	3.74	\$141.67
2. 4 cwts. Sulphate of Ammonia	94	—	—	45.56	11.53	3.95	\$143.78
3. 6 cwts. Sulphate of Ammonia	141	—	—	48.00	11.19	4.29	\$136.52
4. 8 cwts. Sulphate of Ammonia	188	—	—	43.12	10.73	4.02	\$137.02
5. 6 cwts. Sulphate of Ammonia + 3 cwts. Superphosphate	141	134	—	46.50	10.84	4.29	\$133.98
6. 8 cwts. Sulphate of Ammonia + 3 cwts. Superphosphate	188	134	—	45.75	10.42	4.39	\$129.73
7. 6 cwts. Sulphate of Ammonia + 3 cwts. Superphosphate + 2 cwts. Muriate of Potash	141	134	134	44.44	11.57	3.84	\$145.78
8. 8 cwts. Sulphate of Ammonia + 3 cwts. Superphosphate + 2 cwts. Muriate of Potash	188	134	134	42.19	11.19	3.77	\$144.24
9. 1100 lbs. Ammo-phos-Ko (13:13:13)	143	143	143	43.88	10.60	4.14	\$134.30
LSD P = 0.05				11.38	2.39	1.14	

Fertilizer Trial

Location : La Fortunee H54 Date Planted : 19/8/58
 Design : 4 x 12 Randomised Blocks Date Reaped : Advanced plants — 18/2/60
 Split plots lime and no lime 1st Ratoons — 11/4/61
 Plot Size : ½ plot 1/40th Acre 2nd Ratoons — 2/2/62
 Soil Type : Talparo Clay
 Soil Analysis : See below
 Variety : B 45224

This is a long term trial having been continued for 20 years. It is a test of 3 levels of nitrogen and 4 of phosphate in the presence of absence of lime. Each time the field is ploughed, lime is applied to the 'A' plots to satisfy the full lime requirement.

Treatment per acre	'A' plots Free lime			Pre- processing cost per ton sugar R(C/Y + H)	'B' plots No lime			Pre- processing cost per ton sugar R(C/Y + H)
	TC/A	TC/TS	TS/A		TC/A	TC/TS	TS/A	
1. 3 cwts. Sulphate of Ammonia	27.00	11.64	2.32	\$187.28	28.75	13.13	2.19	\$204.17
2. 6 cwts. Sulphate of Ammonia	28.75	11.55	2.49	\$179.60	29.75	12.77	2.33	\$195.00
3. 9 cwts. Sulphate of Ammonia	21.50	11.94	1.80	\$219.22	28.50	12.34	2.31	\$192.75
4. 3 cwts. Sulphate of Ammonia + 1½ cwt. 40% Superphosphate	20.50	11.99	1.71	\$226.73	25.00	12.50	2.00	\$210.00
5. 6 cwts. Sulphate of Ammonia + 1½ cwt. 40% Superphosphate	30.50	12.45	2.45	\$187.62	25.00	12.32	2.03	\$206.98
6. 9 cwts. Sulphate of Ammonia + 1½ cwt. 40% Superphosphate	27.25	12.44	2.19	\$199.16	27.50	13.41	2.05	\$213.62
7. 3 cwts. Sulphate of Ammonia + 3 cwts. 40% Superphosphate	21.25	11.94	1.78	\$220.77	27.25	12.33	2.21	\$197.40
8. 6 cwts. Sulphate of Ammonia + 3 cwts. 40% Superphosphate	24.25	12.13	2.00	\$207.42	26.00	12.04	2.16	\$197.82
9. 9 cwts. Sulphate of Ammonia + 3 cwts. 40% Superphosphate	26.25	12.38	2.12	\$202.29	25.00	12.82	1.95	\$215.38
10. 3 cwts. Sulphate of Ammonia + 4½ cwt. 40% Superphosphate	28.00	12.67	2.21	\$199.81	24.25	12.50	1.94	\$213.75
11. 6 cwts. Sulphate of Ammonia + 4½ cwt. 40% Superphosphate	25.25	12.38	2.04	\$206.75	26.00	11.50	2.26	\$188.95
12. 9 cwts. Sulphate of Ammonia + 4½ cwt. 40% Superphosphate	30.00	11.85	2.53	\$180.12	34.00	11.33	3.00	\$161.57
LSD P = 0.05	15.20	2.07	1.36		17.10	2.08	1.40	

Fertilizer Trial

Location: Picton Pa. 8
Date Planted: 16/9/58
Design: 10 x 4 Randomised Blocks
Date Reaped: Young plants — 5/5/59
Plot Size: 1/30th Acre
 1st Ratoons — 18/4/60
Soil Type: Alluvial Black
 2nd Ratoons — 23/2/61
Soil Analysis: P2O5 — 0.005%
 3rd Ratoons — 21/3/62
 K2O — 0.020%

Lime requirement 2.59 tons per acre

Variety: B 45224

Treatment per acre	lbs. active per acre			TC/A	TC/TS	TS/A	Pre-processing cost per ton sugar R(C/Y + H)
	N2	P2O5	K2O				
1. Control — nil	—	—	—	35.16	9.90	3.55	\$138.90
2. 4 cwts. Sulphate of Ammonia	94	—	—	36.75	10.38	3.92	\$135.98
3. 6 cwts. Sulphate of Ammonia	141	—	—	40.68	9.80	3.75	\$134.55
4. 8 cwts. Sulphate of Ammonia	188	—	—	40.22	9.86	4.08	\$129.86
5. 6 cwts. Sulphate of Ammonia + 3 cwts. 40% Superphosphate	141	134	—	39.19	9.47	4.14	\$126.14
6. 8 cwts. Sulphate of Ammonia + 3 cwts. 40% Superphosphate	188	134	—	39.19	10.15	3.86	\$135.20
7. 6 cwts. Sulphate of Ammonia + 3 cwts. 40% Superphosphate + 2 cwts. Muriate of Potash	141	134	134	41.25	9.94	4.15	\$129.42
8. 8 cwts. Sulphate of Ammonia + 3 cwts. 40% Superphosphate + 2 cwts. Muriate of Potash	188	134	134	40.88	9.40	4.35	\$122.86
9. 700 lbs. Ammo-phos-Ko (10:20:20)	141	140	140	40.41	9.90	4.08	\$130.09
10. 1100 lbs. Ammo-phos-Ko (13:13:13)	143	143	143	40.31	9.60	4.20	\$126.24
LSD P = 0.05				10.83	1.28	1.35	

Fertilizer Trial

Location: Reform 8
Design: 10 x 5 Randomised Blocks
Plot Size: 1/30th Acre
Soil Type: Sevilla Clay
Variety: B 37172

Date Planted: 4/3/58
Date Reaped: Young plants — 27/4/59
 1st Ratoons — 2/4/60
 2nd Ratoons — 1/3/61
 3rd Ratoons — 1/2/62

Treatment per acre	TC/A	TC/TS	TS/A	Pre- processing cost per ton sugar R (C/Y + H)
1. Control — nil	18.15	9.26	1.96	\$189.09
2. Control — nil	20.10	9.57	2.10	\$183.17
3. 4 cwts. Sulphate of Ammonia	24.75	9.38	2.64	\$158.52
4. 6 cwts. Sulphate of Ammonia (standard)	26.10	9.06	2.88	\$148.58
5. 8 cwts. Sulphate of Ammonia	24.75	9.10	2.72	\$153.79
6. 204 lbs. Urea (equivalent to '3' in nitrogen)	22.95	9.52	2.41	\$168.12
7. 307 lbs. Urea (equivalent to '4' in nitrogen)	24.75	9.24	2.68	\$156.16
8. 409 lbs. Urea (equivalent to '5' in nitrogen)	25.20	9.77	2.58	\$163.35
9. 6 cwts. Sulphate of Ammonia	25.20	9.26	2.72	\$154.83
10. 307 lbs. Urea after rain	25.50	9.44	2.70	\$156.80
LSD P = 0.05	4.93	0.76	0.55	

Appendix 76.

Manufacturer	Chemical	Chemical Composition	lbs. or % active	Rates tested at per acre
Rohm & Haas	Stam F 34	3,4 dichloropropionanilide	3 lbs/gal. U.S.	3 + 6 lbs.
Amchem	Amiben	Triethyl amine salt of 3-amino-2, 5 dichloro benzoic acid	2 lbs/gal. U.S.	3, 4 + 5 lbs.
Amchem	Fenac	2,3,6 trichlorophenyl acetic acid	1.5 lbs/gal. U.S.	2, 3, 4 lbs.
Amchem	ACP 62-74	* 2,3,6-trichlorophenylacetic acid + 3-amino-2,5-dichlorobenzoic acid	* $\frac{3}{4}$ lb/U.S. gal) 1.75 80% + 1 lb/U.S. gal.) lb/U.S.	1.2, 2.4 + 4.8 lbs.
Du Pont	Lorox	3-(3,4-dichlorophenyl)-1-methoxy-1-methyl urea	50% Powder	0.5, 1.0 + 1.5 lb.
Du Pont	Hyvar	5-bromo-3-isopropyl-6-methyl uracil	80% Powder	2.4, 4.8 + 7.2 lbs
Du Pont	Karmex	3,(3,4 dichlorophenyl)-1, 1-dimethyl urea	80% Powder	2.4 + 3.2 lbs.
Fisons	Simazine	2-chloro-4, 6-bis (ethylamino)-s-triazine	50% Powder	2.5 + 3.0 lbs.
Fisons	Atrazine	2-chloro-4-ethylamino-6-isopropylamino-s-triazine	50% Powder	2.0 + 2.5 lbs.
Fisons	Pesco 1815	Trichlorobenzoic acid + (4,e methylchlorophenoxy acetic acid)	48 gram/litre TBA +)198 150 gram/litre MCPA)g/1	3, 4 + 5 lbs.
Dow	Dowpon	2,2-dichloropropionic acid Na salt	85%	3.4 lbs.
Dow	Kuron	2, -(2,4,5 trichlorophenoxy) propionic acid, propylene glycol, butyl ether esters	4 lbs/gal. U.S. (64.5%)	3, 4 + 5 lbs.
Dow	DMA 6	Dimethyl amino salt of 2,4-D	6 lbs/U.S. gal.	0.63 lb.
Diamond Alkali	LV 6	Ethyhexyl ester of 2,4-D	6 lbs/U.S. gal.	0.90 + 1.35 lb.
BASF	Alipur	Cyclooctyl-dimethyl urea + butinyl-m-dichlorophenyl carbamate	2 lbs/U.S. gal.	3, 4 + 5 lbs.
Shell	WL 5792	undisclosed	50%	1, 2 + 3 lbs.
Monsanto	CP 31675	undisclosed	undisclosed	1, 2 + 3 lbs.
Hercules	Hercul. 7531	-1-(5-(3a,4,5,6,7,7a-hexahydro-4,7-methanoindenyl))-3,3-dimethyl urea	80%	2.4, 3.2, + 4.0 lbs.
Hercules Powder	Hercul. 7175	-1-(chloro-2-norbornyl)-3,3-dimethyl urea	80%	2.4, 3.2, + 4.0 lbs.
Hercules Powder	Fernamine	2,4-D Amine	5 lbs/gal.	0.63 lb.

Appendix 77.

Herbicide Trial

Location: Petit Morne 26 (1)

Date Planted: 19/6/61

Design: 6 x 6 Latin Square

Date Reaped: Young plants — 14/4/62

Plot Size: 1/40th Acre

Soil Type: Alluvial Black

Variety: B 49119

Treatment per acre	TC/A	TC/TS	TS/A
1. 3 lbs. Karmex + 1 pint Amine	36.58	9.94	3.68
2. 5 lbs. Simazine + 1 pint Amine	35.08	9.64	3.64
3. 5 lbs. Atrazine + 1 pint Amine	34.66	9.85	3.52
4. 4 pints Amine 2,4-D (1 spray)	36.08	9.83	3.67
5. 4 + 4 pints Amine 2,4-D (2 sprays)	34.66	9.47	3.66
6. 4 + 4 + 4 pints Amine 2,4-D (3 sprays)	35.16	9.50	3.70
LSD P = 0.05	5.46	1.09	0.80

No effect on the yield of cane or sugar resulted from the use of these herbicides.

Appendix 78.

Herbicide Trial

Location: Petit Morne 26 (2) *Date Planted:* 19/6/61
Design: 9 x 3 Randomised Blocks *Date Reaped:* Young plants 16/4/62
Plot Size: 1/40th Acre
Soil Type: Alluvial Black
Variety: B 49119

Treatment per acre	TC/A	TC/TS	TS/A
1. Control	35.16	9.50	3.70
2. 3 lbs. Karmex + 1 pint Fernamine 2,4-D	35.50	9.70	3.66
3. 5 lbs. Simazine + 1 pint Fernamine 2,4-D	35.16	9.61	3.66
4. 1 gallon Fenac	33.33	10.04	3.32
5. 2 gallons Fenac	32.50	9.53	3.41
6. 3 gallons Fenac	36.50	10.00	3.65
7. ½ gallon Kuron	38.50	9.77	3.94
8. 1 gallon Kuron	34.50	9.48	3.64
9. 1½ gallon Kuron	34.00	9.80	3.47
LSD P = 0.05	11.66	1.54	1.49

No effect on the yield of cane or sugar resulted from the use of these herbicides.

Appendix 79.

Herbicide Trial

Location: Petit Morne 30 *Date Planted:* 12/8/60
Design: 5 x 5 Latin Square *Date Reaped:* Young plants — 22/5/61
Plot Size: 1/40th Acre 1st Ratoons — 27/4/62
Soil Type: Princes Town Marl
Variety: B 49119

Treatment per acre	TC/A	TC/TS	TS/A
1. 3 lbs. Karmex + 1 pint Amine 2,4-D	37.30	9.16	4.07
2. 3 lbs. Karmex + 1 pint Amine 2,4-D + 2 pints Albolineum	37.90	9.15	4.14
3. 3 lbs. Karmex + 1 pint Amine 2,4-D + 4 pints Albolineum	37.60	9.22	4.08
4. 3 lbs. Karmex + 1 pint Amine 2,4-D + 6 pints Albolineum	37.60	9.22	4.08
5. 3 lbs. Karmex + 1 pint Amine 2,4-D + 8 pints Albolineum	38.10	8.66	4.40
LSD P = 0.05	5.18	1.09	0.81

The addition of Albolineum at four rates to the standard "Karmine" mixture had no effect on the final yields in spite of slight yellowing of the lower leaves for a period in the 4, 6, and 8 pints Albolineum plots.

Appendix 80.

Herbicide Trial

Location : Picton Pa 19A (1)

Date Planted : 21/6/61

Design : 6 x 6 Latin Square

Date Reaped : Young plants — 11/5/62

Plot Size : 1/40th Acre

Soil Type : Alluvial Black

Variety : B 50112

Treatment per acre	TC/A	TC/TS	TS/A
1. 3 lbs. Karmex + 1 pint Amine 2,4-D	29.58	8.31	3.56
2. 5 lbs. Simazine + 1 pint Amine 2,4-D	26.08	8.25	3.16
3 5 lbs. Atrazine + 1 pint Amine 2,4-D	28.16	8.14	3.46
4. 4 pints Amine 2,4-D (1 spray)	25.25	8.33	3.03
5. 4 + 4 pints Amine 2,4-D (2 sprays)	23.66	8.24	2.87
6. 4 + 4 + 4 pints Amine 2,4-D (3 sprays)	24.00	8.28	2.90
LSD P = 0.05	8.22	0.50	1.03

No effect on the yield of cane or sugar resulted from the use of these herbicides.

Appendix 81.

Herbicide Trial

Location : Picton Pa. 19A (2) *Date Planted :* 21/6/61
Design : 9 x 4 Randomised Blocks *Date Reaped :* Young plants — 11/5/62
Plot Size : 1/40th Acre
Soil Type : Alluvial Black
Variety : B 50112

Treatment per acre	TC/A	TC/TS	TS/A
1. Control — nil	27.12	8.27	3.28
2. 3 lbs. Karmex + 1 pint Fernamine	29.38	8.54	3.44
3. 5 lbs. Simazine + 1 pint Fernamine	24.12	8.52	2.83
4. 2 lbs. Atraton	29.38	8.25	3.56
5. 4 lbs. Atraton	30.12	8.48	3.55
6. 6 lbs. Atraton	24.25	8.57	2.83
7. ½ gallon Kuron	27.00	8.54	3.16
8. 1 gallon Kuron	23.50	8.05	2.92
9. 1½ gallon Kuron	31.00	8.52	3.64
LSD P = 0.05	14.22	0.38	1.73

No effect on the yield of cane or sugar resulted from the use of these herbicides.

Appendix 82.

Herbicide Trial

Location: Petit Morne C. 29/31/32 *Date Planted:* 23/7/60
Design: 5 x 9 Randomised Blocks *Date Reaped:* Young plants — 30/5/61
Plot Size: 1/40th Acre 1st Ratoons — 15/3/62
Soil Type: Alluvial Red
Variety: B 50112

Treatment per acre	TC/A	TC/TS	TS/A
1. Control — nil	40.90	12.47	3.28
2. 3 lbs. Karmex + 1 pint Amine 2,4-D	39.90	12.63	3.16
3. 5 lbs. Simazine + 1 pint Amine 2,4-D	36.90	12.68	2.91
4. 2 lbs. Fenac	40.50	12.66	3.20
5. 4 lbs. Fenac	37.90	12.72	2.98
6. 6 lbs. Fenac	38.30	12.94	2.96
7. 2 lbs. Kuron	39.60	13.07	3.03
8. 4 lbs. Kuron	38.20	13.50	2.83
9. 6 lbs. Kuron	41.00	13.02	3.15
LSD P = 0.05	7.35	2.28	0.76

No effect on the final yield of cane or sugar resulted from the use of these herbicides.

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